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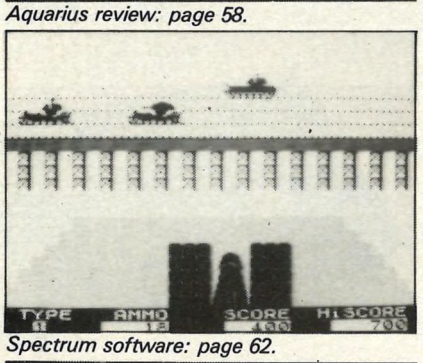
Sharp MZ-700 review: page 52.

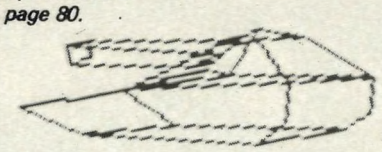
Aquarius review: page 58.



Spectrum software: page 62.

BBC Star Trek: page 94.

Spectrum 3D: page 80.



Cover photograph by Stephen Oliver.

40 **EDITORIAL AND YOUR LETTERS:** Merging on the Vic; and getting hooked on keyboards. Why you can't run BBC programs on a Sinclair.

42 **NEWS:** £70 Laser colour computer; new Tandy micro; Hitachi microfloppy drives for BBC Micro; 96K Lynx.

45 **COMPUTER CLUB:** Paul Bond touches down at Biggin Hill to meet the North Kent Amateur Computer Club.

48 **FIRST BYTES:** This month your introduction to computing tells you what arrays are, how to save space and what high resolution really is.

52 **SHARP MZ-700:** Exclusive review of the 64K micro which has almost everything, including a built-in printer and cassette, except a resident Basic.

58 **AQUARIUS:** Glorified games machine or new generation computer? We find out whether Mattel's 2K Aquarius is more than a toy.

62 **SPECTRUM SOFTWARE:** Meirion Jones discovers that there is more to life than just saving Earth from the Martians and climbing Everest.

70 **CHOOSING A WORD PROCESSOR:** Make the most of your micro with Bill Bennett's guide to word processors.

76 **WRITING A WORD PROCESSOR:** John Dawson tells how he wrote Author — the Oric program which allows you to send out personalised letters by the score.

80 **SPECTRUM 3D ROTATOR:** Three-dimensional images take a turn for the better with the machine-code program for the Spectrum.

84 **ZX-81 SPACE INVADERS:** A new wave of Space Invaders for 16K punks from machine-code crazed Chris Mortimer.

89 **DRAGON FROGGER:** Why did the Dragon cross the road? If you still do not know the answer try Tony Eccles' happy hopper.

94 **BBC STAR TREK:** Space may be the final frontier but you will have no problems fitting this compact game into your BBC model A or B.

98 **VIC LADDERS:** Five hairy monsters are the least of your problems as you dodge the barrels in Martin Lightfoot's game.

101 **ACE MUSIC:** Richard White and the Acettes give you a jingle jangle morning with the Fab Forth.

106 **SPECTRUM STAR WARS:** The Jedi return but whatever happened to the walking machines that helped the Empire strike back?

109 **ATARI SCREEN MIXTURES:** Chris Lam shows you how to break all the rules about which modes you can throw onto the screen at the same time.

114 **VIC MULTI SCREEN:** Switch from one screen to another to add excitement to your games with these Vic routines.

121 **ORIC SNAKE:** Enter Gavin Rummery's Oric game and you will be twisting, twisting, twisting the night away.

122 **FOOD FOR THE DRAGON:** Multi-coloured character food.

127 **BBC PIXEL PLOTTER:** Making life easy for yourself in Mode 7.

132 **ZX-81 GT COMPILER:** David Threlfall's compiler could make your Basic programs run up to 60 times faster.

139 **ZX-81 FAST BASIC:** Speed up your fast mode without losing the picture.

143 **6502 MACHINE CODE:** Darryl Mattocks' guide to assembly code.

149 **RESPONSE FRAME:** Tim Hartnell answers your computing queries.

181 **COMPETITION CORNER:** More puzzles and the Texas winner.

153 **SOFTWARE FILE:** 10 program-packed pages full of games and tips for the Oric, Lynx, Commodore 64, Atom, ZX-81, BBC, Vic-20, Dragon and Spectrum.

WIN AN ACORN ELECTRON: Win Acorn's new wonder micro. Card between pages 38 and 39.

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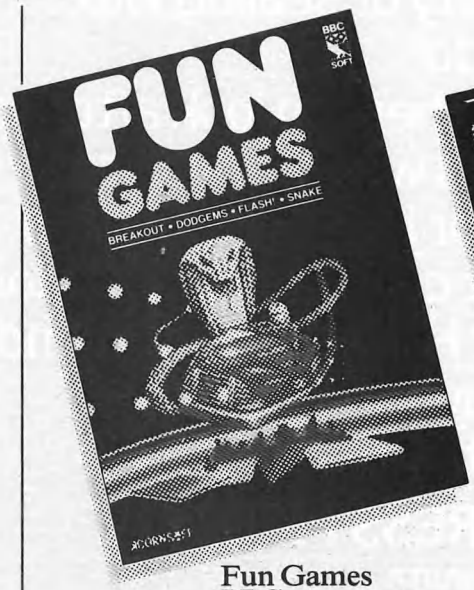

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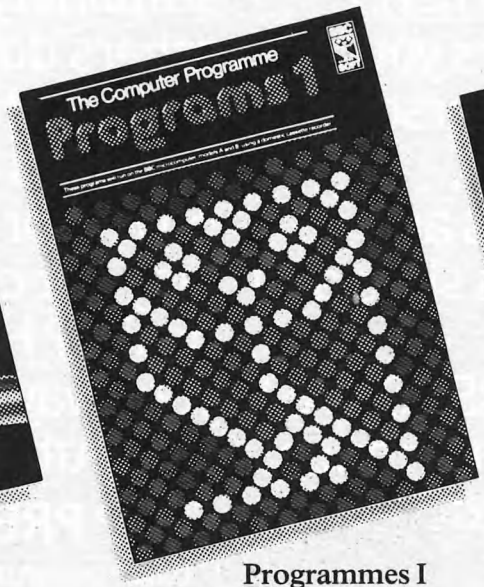

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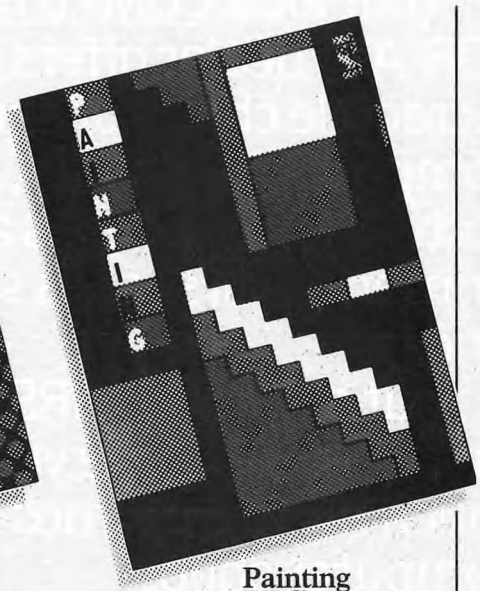

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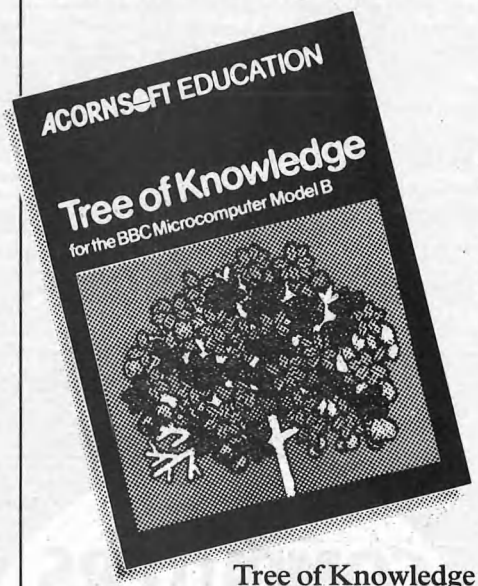

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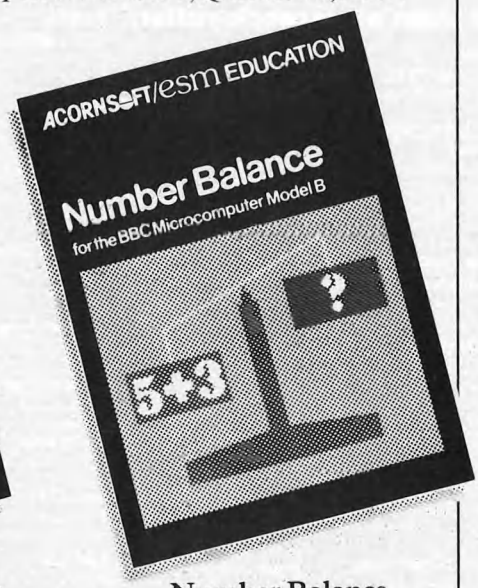

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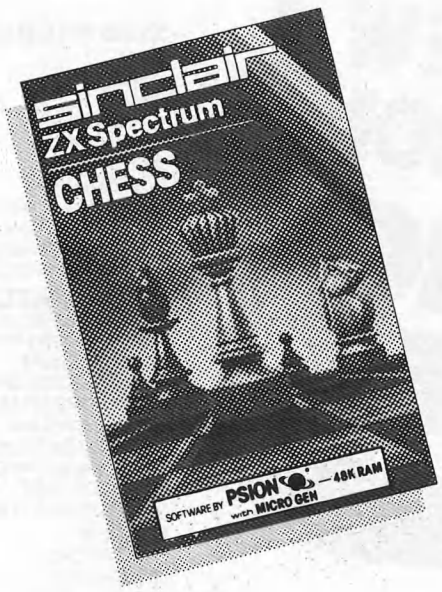

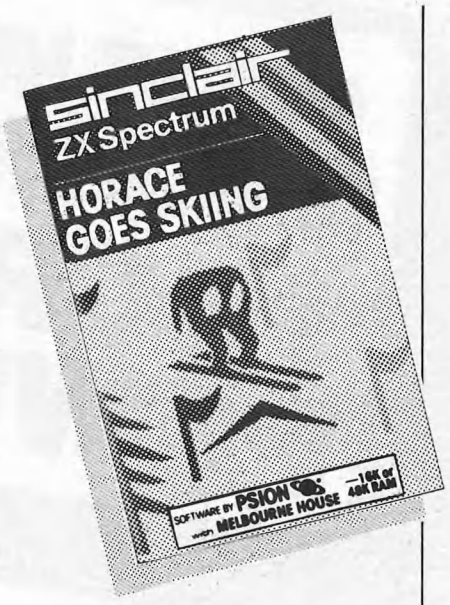

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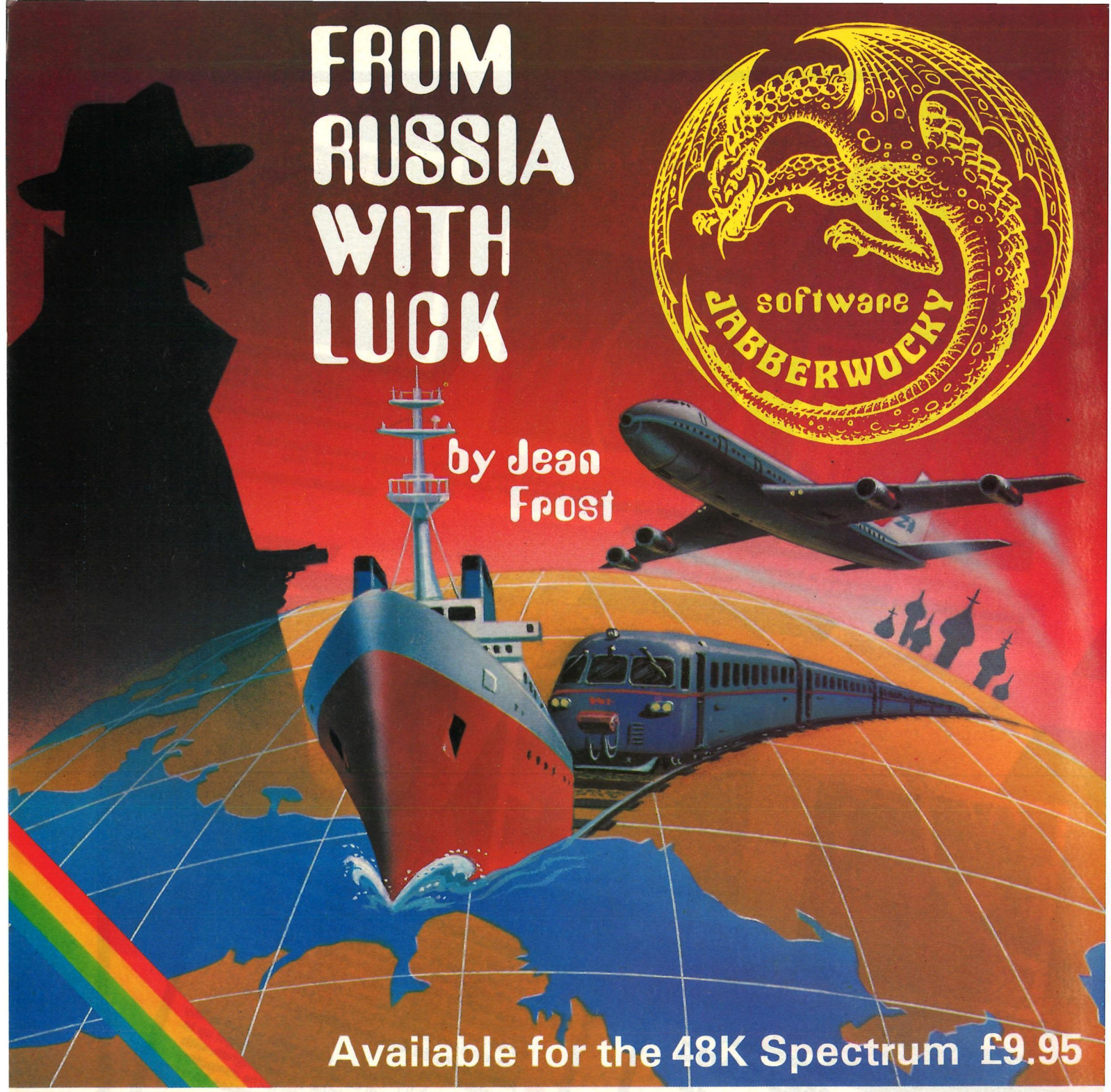

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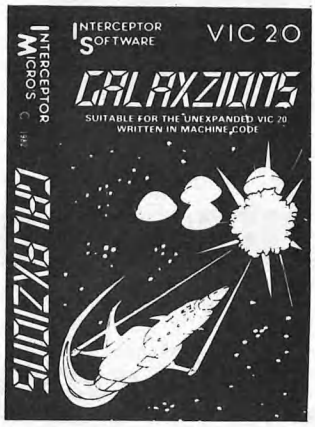

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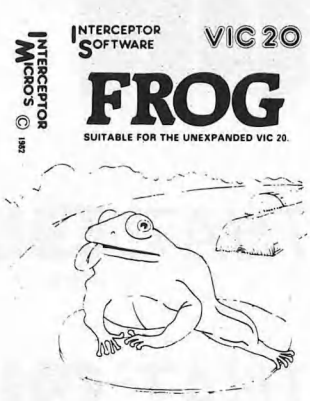

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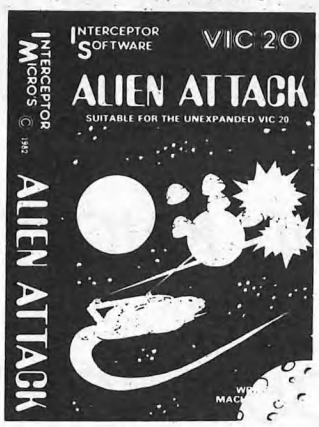

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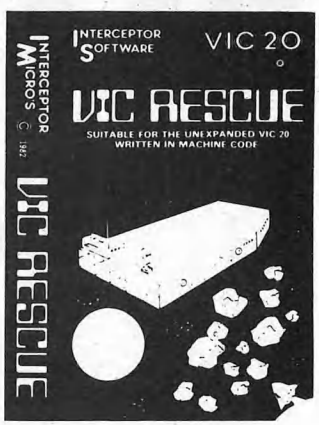

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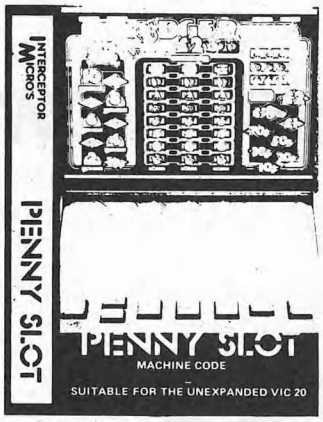

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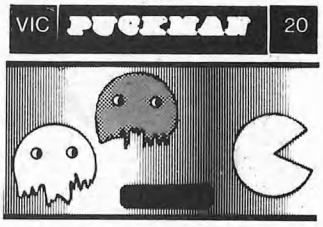

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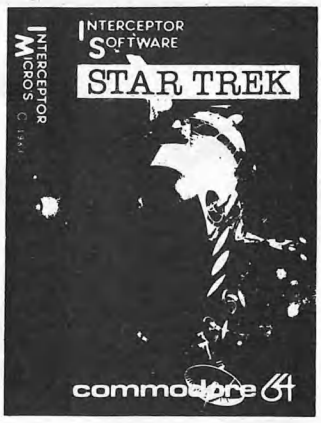

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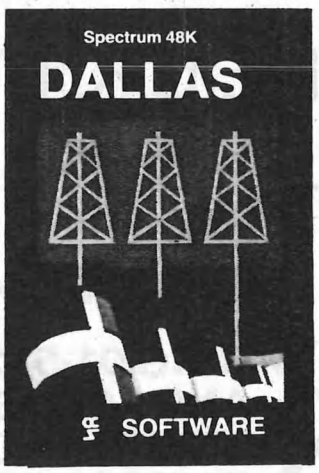

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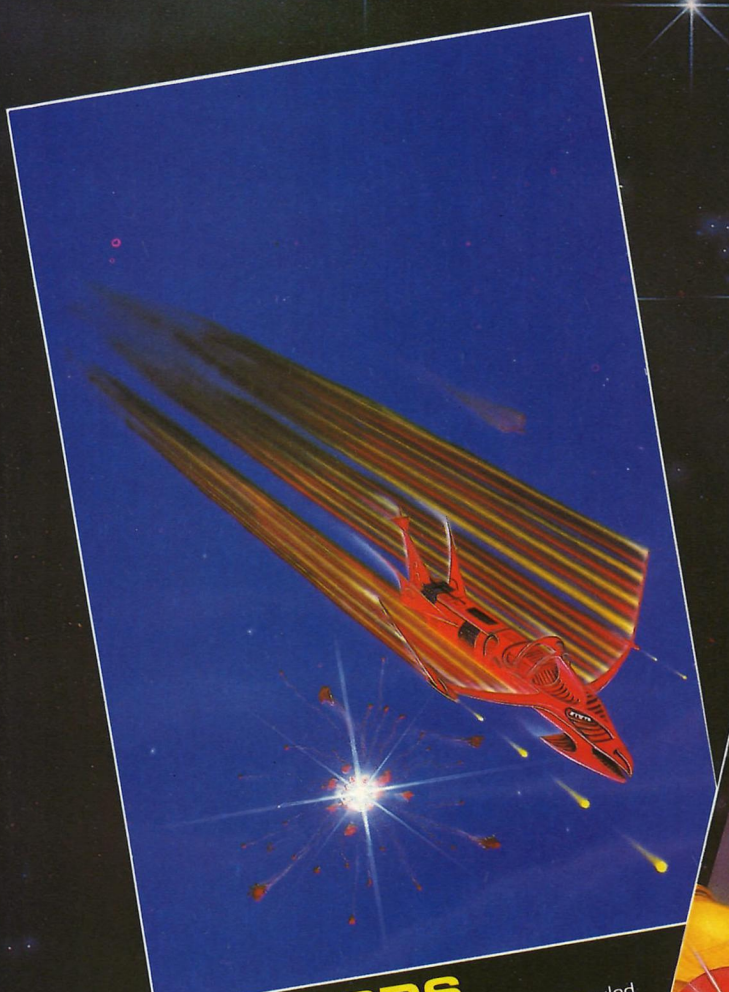

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Hidden in the folds of time's cloak lie tales of the Shadow Lords and battles with the Eidrons. But these are times when Myth and Reality mingle, for Lo! the Shadow Lords are come. You White Knight, are the sole remaining keeper of an Ostron and Sage of the Old Lore . . . You are Man's last hope!
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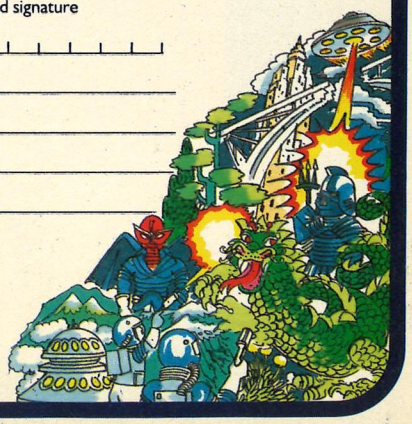

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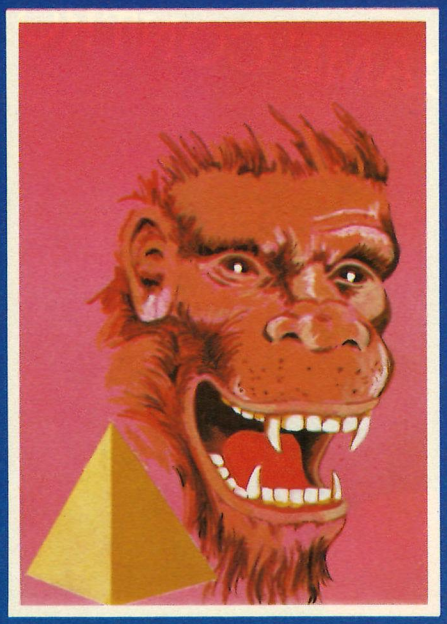

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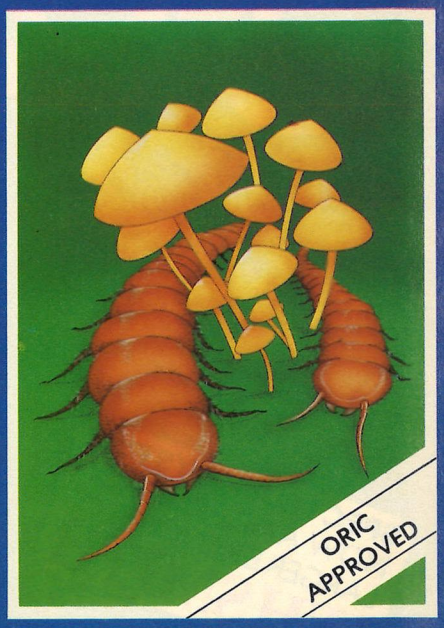

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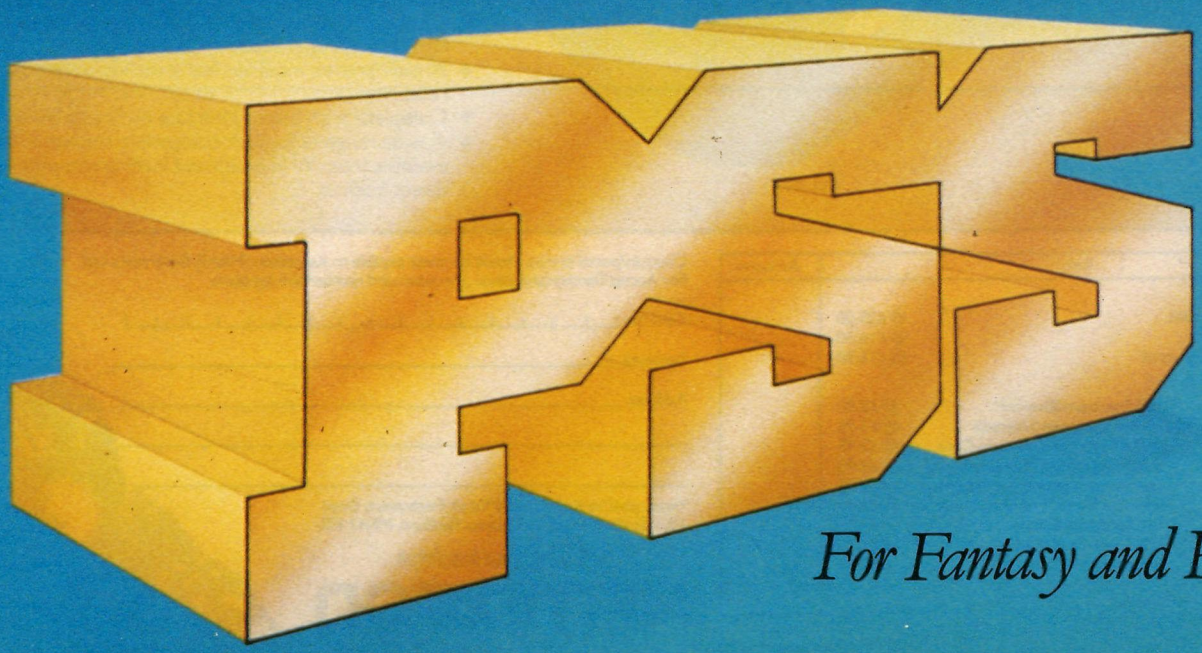

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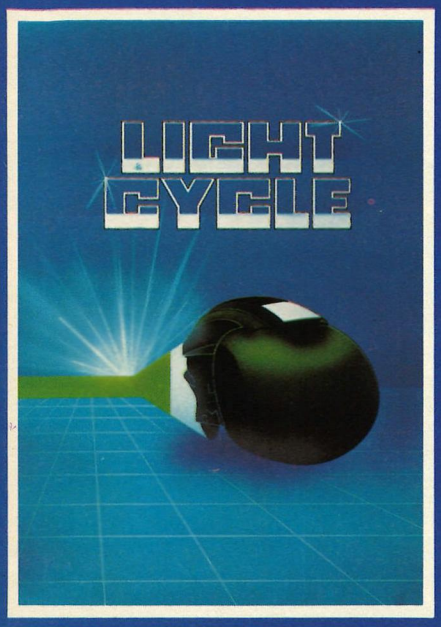

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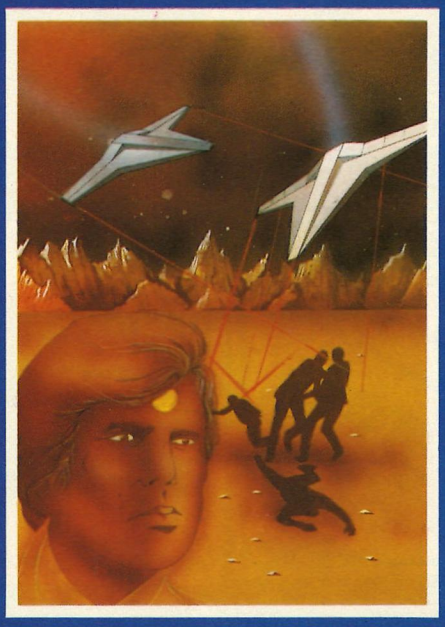

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Attack is a super fast, all machine code arcade style game. You are the Chief Security Officer on the prison planet 'KOVENTRI' where all the captured space invaders are kept until a humane way of dealing with them can be found. There has been a major breakout and it is a race against time to stun the invaders and return them to the compound. After being in the open too long they mutate and become much fiercer. See how long you can keep them all locked up.

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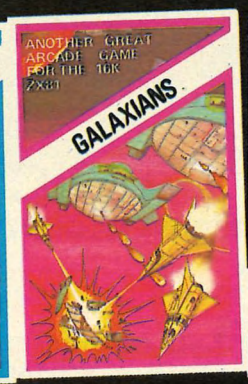

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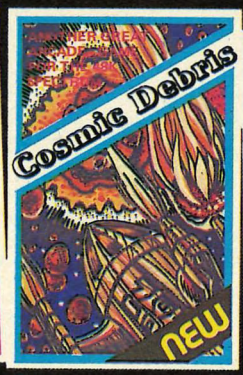

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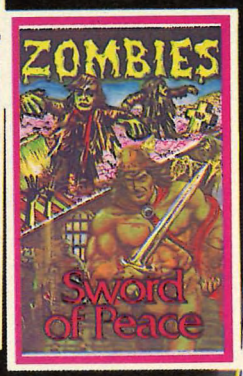

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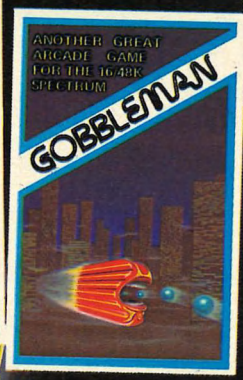

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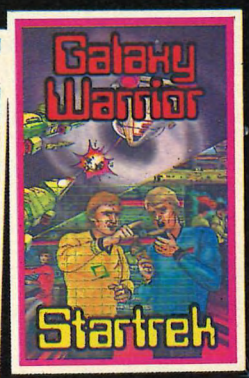

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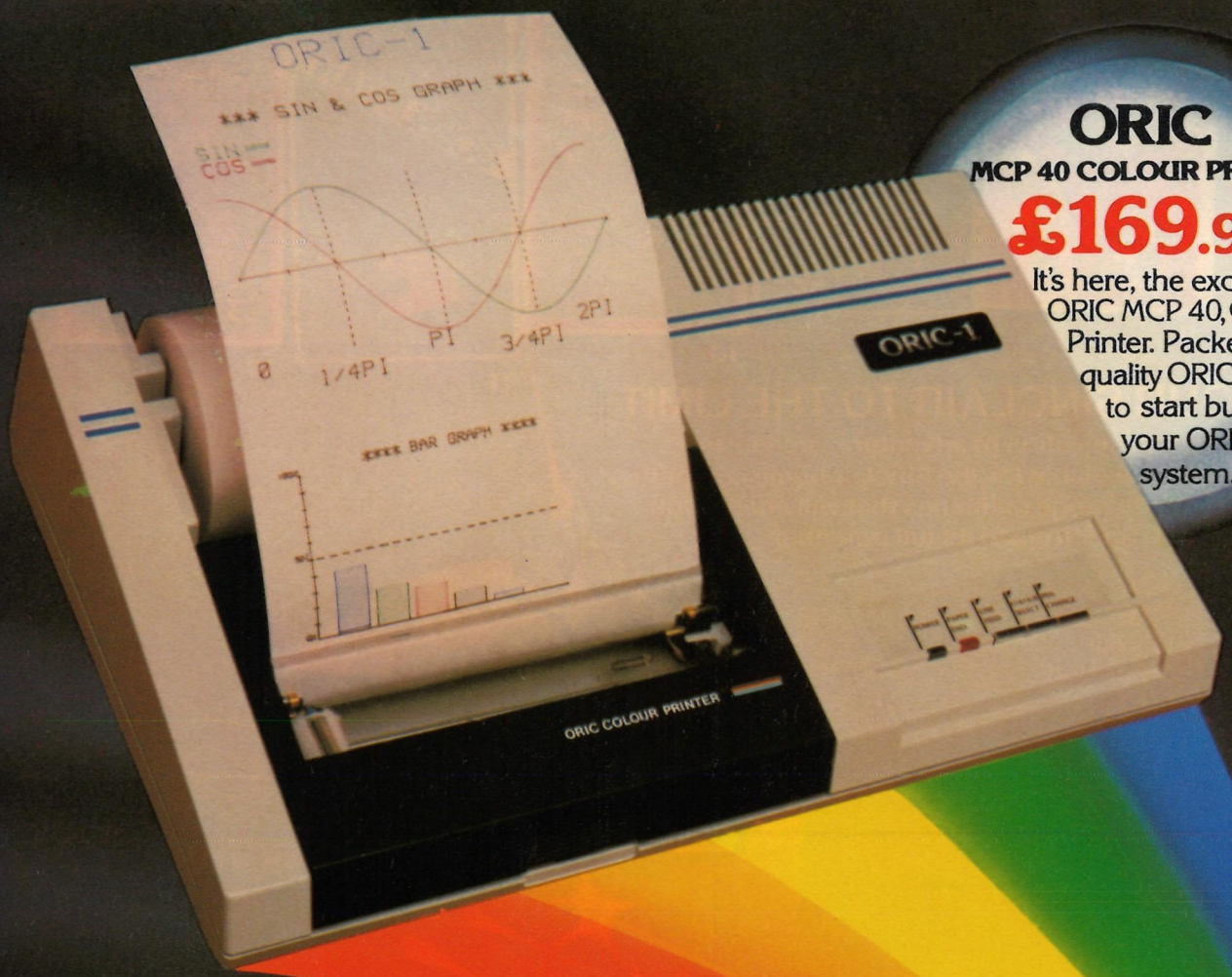

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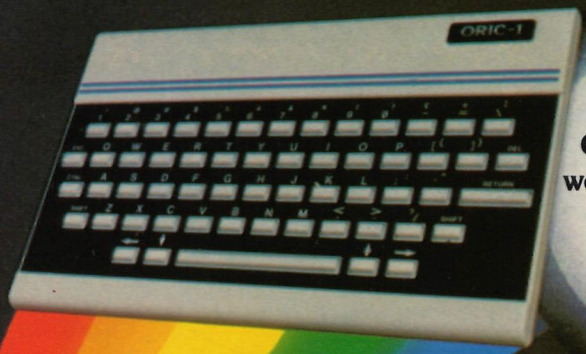

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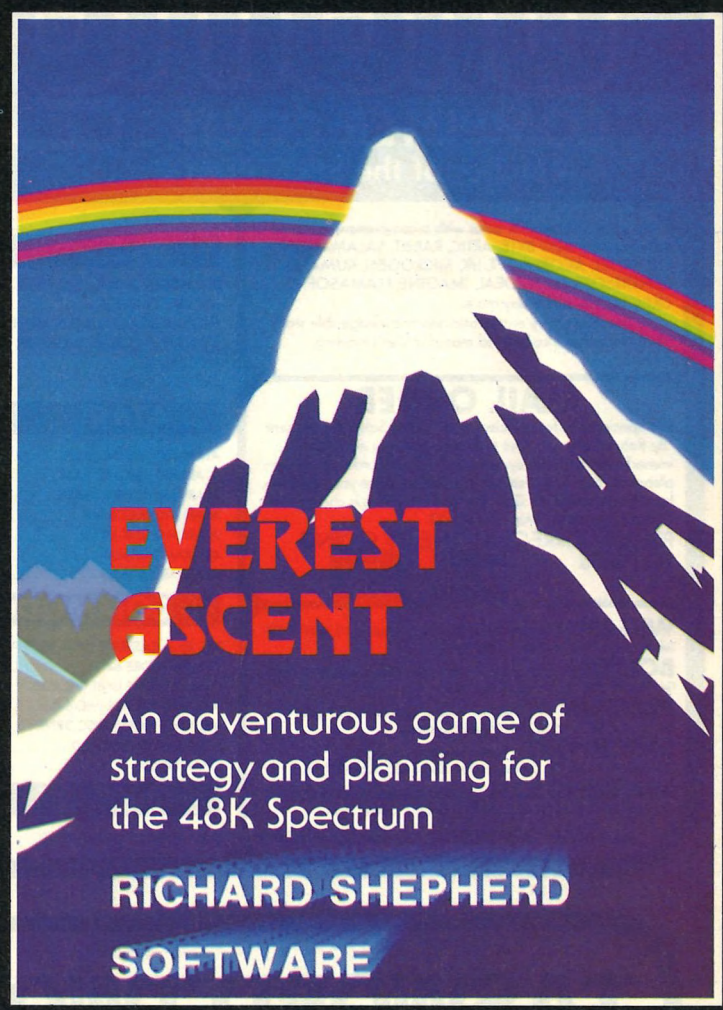

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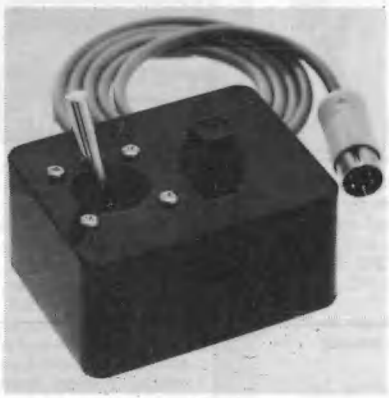

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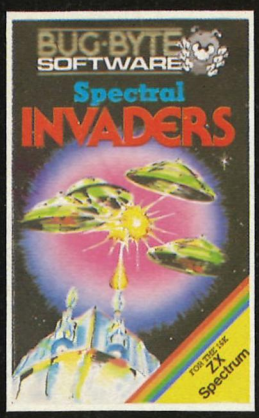

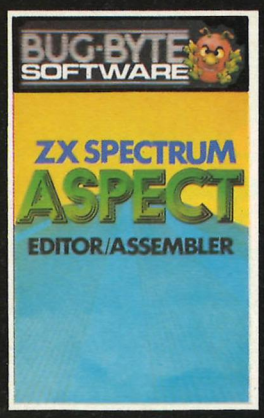

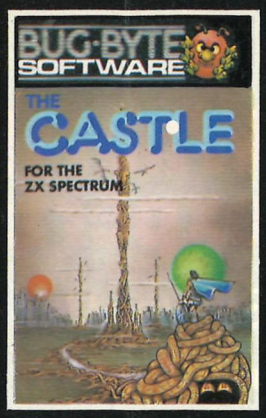

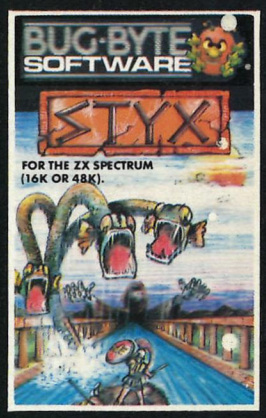

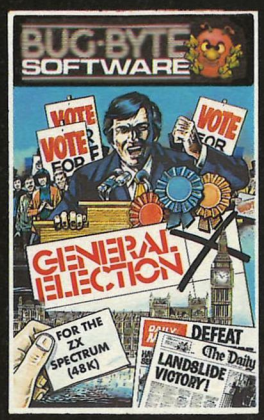

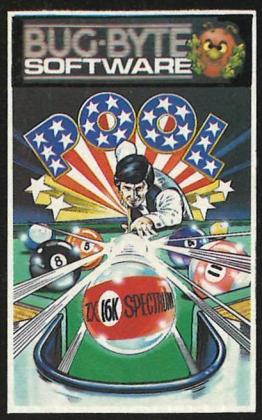

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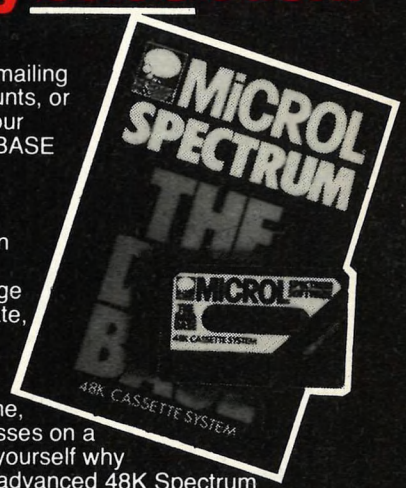

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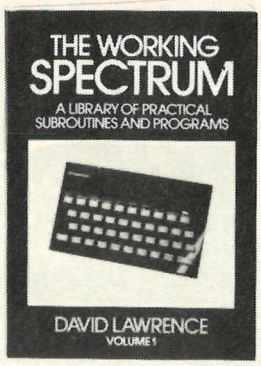

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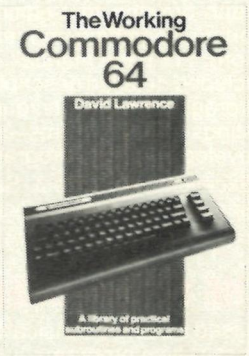

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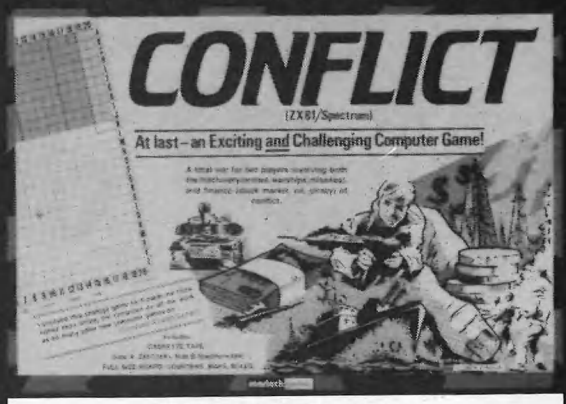

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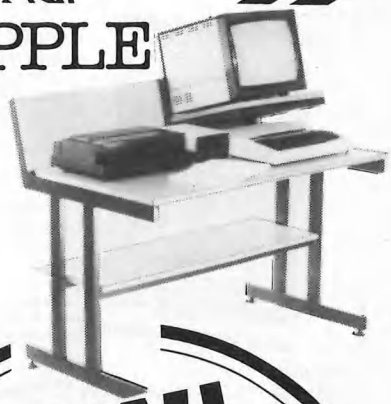

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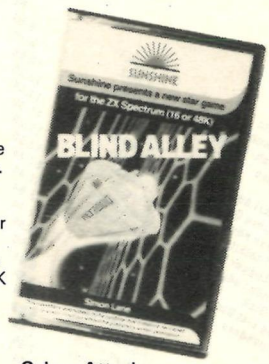

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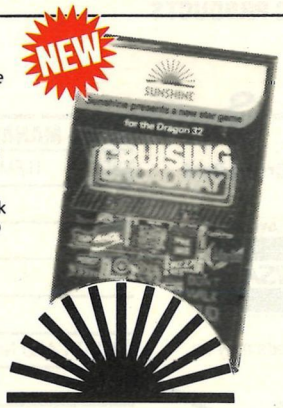

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We have a serious problem concerning not a computer but a keyboard junkie. After buying a ZX-81 about a year ago he has been tapping away constantly ever since. He very often programs into the early hours.

Recently he purchased a Jupiter Ace and this has only made matters worse. We have tried several times, but to no avail, to rip him away from the keyboard. Some of my friends have even attempted a social rehabiliation course but this as yet has proved unsuccessful. To show the extent of this addiction his parents recently bought a new microwave oven, to which news he replied, "How do you program it?"

It seems to us that computers are a danger and potential black spot. Is he the first real computer-holic and in need of medical help? Please could you advise a cure, short of jumping on his Jupiter Ace, or perhaps advise a decent psychologist.

Richard, Bateson, Slough, Berkshire.

EDITOR

Unfortunately the code for routine OA, the Run routine, was left out in the listing in July for my Spectrum editor. There is also an error in table 3 which contains the changes to be made for 48K. 2A207F nine rows up from the bottom in the left hand column should read 2A307F and the corresponding entry for 48K should be 2A30FF. As published the program will run perfectly so long as you do not call routine OA. Here are the missing 96 bytes which run from 739F to 73F4:

```
739F  E5 D5 C5 F5 06 02 21 33
73A7  75 CD 31 7A CD 6B 0D FD
73AF  CB 02 86 FD CB 30 9E 2A
73B7  32 7F 11 28 7F 01 03 00
73BF  ED B0 2B 13 13 EB 01 03
73C7  00 ED B8 F1 C1 D1 E1 22
73CF  30 7F 2A 34 7F E5 2A 30
73D7  7F C9 ED 73 30 7F E5 D5
73DF  C5 F5 FD E5 DD E5 D9 E5
73E7  D9 E5 D9 D5 D9 D5 D9 C5
73EF  D9 C5 08 F5 08 F5 08 F5
73F7  08 F5 21 28 7F ED 5B 32
73FF  7F
```

STRING BONUS

Your correspondent Jack Schofield, Letters, April, is not quite correct in his claim that string arrays are useless, at least not as far as the ZX-81 is concerned. A single dimensioned string array has two distinct advantages that I can think of.

It can be of greater overall maximum length than an ordinary linear string. The maximum possible length of a linear string on a 16K ZX-81 is something over 7K, whereas a Dim array can be of over 15K bytes.

If positioned at the beginning of the variables file — by making it the first variable to be formed in operation of the program, it remains in the same place during operation of the program, regardless of what is done to it, apart from re-Diming it, of course. This makes it very useful for storage of data for machine-codes, avoiding the need for a search and find routine.

I must admit that I have not found much use for multi-dimensioned string arrays, but it is on occasion quite useful to be able to set aside a fixed amount of RAM within the Basic area, and the Dim string array is a neat way of doing this.

Nick Godwin, Berwickshire, Scotland.

SCRAM-20

I must apologise to all 8K and 16K Vic-20 owners who will have encountered problems in entering Scram-20. However, I have come up with the following solution which applies to 8K and 16K only.

Use the second set of Pokes which will make your Vic think it is unexpanded. As the extra RAM is still there, the code must be put in the free space. So let the start address which corresponds to 4100 be 12288, and let the finishing address which corresponds to 7679 be 15867. Now Erase line 9 in the loader, and correct the following lines in the loader:

54 Change (Print x;) to (Print x-8188)
55 Change (Print x;) to (Print x-8188)
601 Change (Poke 781, 255) to (Poke 781, 251)
602 should read: (Poke 782, 61: Poke 0, 0: Poke 1, 48)
485 change (Poke LO, DT) to (Poke LO+8188,DT)

Add this line:

49 (UU=UU+8188:VV=VV+8188)

Now when asked for the start and finishing addresses, you can just use the numbers from 4100 to 7679 as the movement to the free space is taken care of in line 49 — the difference between 12288 and 4100 is 8188. Also when asked for the start of the load, you must enter 12288. When the program is on tape and run, the code is relocated between 4100 and 7679. Finally, F1 is the start for a one player game and F3 for a two player game. Also, to move left you must release all controls.

Nalin Sharmam, Walthamstow, London.

SPECTRUM SPEAKS

There is a mistake in the article accompanying the Spectrum Speaks program in the June issue. CLEAR 32767 followed by a New command should be the first instructions you type in. They should not follow the Save command — as suggested in the article — but should precede it. Otherwise the article and listings are error free.

John Edwards, Solihull, West Midlands.

DISASSEMBLER

Brian Cadge's disassembler program for the Dragon 32, published in *Your Computer*, May 1983, contains some very clever programming tricks that are well worth working through and copying but: the last but one mnemonic in line 890, currently ERR, should be LIBRA space %. The mnemonic after it is usually spelt LBSR. The mnemonic between RTS and RTI in the second line of statement 910 is not ERR but ABX. The fifth mnemonic from the end of statement 980 is not ADD space > but ADD space B space > and the sixth mnemonic in statement 990 is not ADD space A space & but ADD space D space &.

A right-hand square bracket is needed between the inverted commas in statement 570.

The indexed addressing post bytes 145 to 149 and their equivalents 32, 64 and 96 higher are completely ignored. As with the illicit values 135, 142, 143 and 144, and their equivalents 32, 64 and 96 higher, the program is content to print a left-hand square bracket and a register name before going on to the next instruction. Luckily these instructions are rarely used in the ROM.

The output is not in the conventional Motorola format and this could lead to confusion. The main differences are:

ADDRESS	CADGE	CONVENTION
Immediate	30	#30
Direct	(30)	30 or <30 or 30 DP
Extended	(3030)	3030
Indexed, direct	[something]	something
Indexed, indirect	[X	[something]

The Direct Page register is assumed to be clear, which is not necessarily the case.

Five-bit indexed addressing is not properly disassembled but can be handled once the following substitution has been made.

```
550 IF PEEK(1) > 127 THEN 560 ELSE
    N = PEEK(1) AND 31
555 IF N < 16 THEN
    PRINT#PR," + "N"]";:GOTO670
    ELSE PRINT#PR,N-32"]";:GOTO
    670
```

Users should be wary when trying any disassembler on the Basic interpreter. Machine code proper starts at 33527, being preceded by tables of reserved words and jump vectors. There are also a number of words and tables embedded in the rest of the ROM; 34565 to 34569 contains the word ?Redo, which gets "disassembled" as

SWI 1 ERR ERR LSR A CLR A TST (0)

There are several five-byte numbers in Basic variable format, nine falling

EASIER TO DIGEST

In the article entitled Variables First Course on a Plate in the April issue, Mr Clive Finnis quoted an incredibly complicated merge procedure by Jim Butterfield for the Vic-20. There is, however, a much simpler technique which requires four Pokes and two Peeks, and has the added advantage of being able to load normal binary program files.

First — assuming you have your program in memory — type

POKE43,PEEK(45)-2:POKE44,PEEK(46)

then load your routine normally. If you List now you will find your original program has been replaced by the routine. Now for the final part, type

POKE43,1:POKE44,16

this is start of Basic for an unexpanded machine. Now List and you will find the routine appended to your program. Provided you type in the instructions in this order nothing can go wrong. It can only break down on two occasions: when

PEEK(45) = 1 or 0

The editor will catch the error in these cases. What you are doing is setting the start of Basic pointer to the Variable pointer -2 this will always be the end of program link pointed at by the previous link.

When you load the routine, the first link in the program goes here so that after restoring the start of Basic the Line-Links all link together so to speak. Anyway, so that you can practice, here is a renumber routine. One final thing: you must make sure that the routine line numbers are higher than any of the program numbers. Jim Butterfield's method is useful for merging lower line numbers — but who wants to do that anyway?

Alan Westwood, London.

between 37390 and 37435. These can often be spotted by register X being loaded with an address in the vicinity of the table or variable. The interpreter also contains a number of dummy instructions, the address bytes being used as a complete instruction when the program counter branches in from elsewhere. CMPX — code 140 — is the most common dummy but LDA — code 134 — and BRN are also used.

Stephen Hunter,
Southampton,
Hampshire.

ONE MAN'S MOWER

My compliments to Shingo Sugiura for his original and entertaining game of Mower — *Your Computer* April 1983 — on which my children have spent many happy hours. I have, however, experienced two difficulties with the program, namely the control of the mower is rather imprecise and spurious restarts can occur for no apparent reason.

The first problem is caused by the program waiting at line 110 for a fixed period of time before inspecting the keyboard for a particular key depression. The response can be improved without any serious degradation in the background music by adding lines 315 to 316 and replacing lines 110 to 170 thus:

```
110 PROCDISPLAY
120 PROMUSIC
130 k=INKEY (WAIT%/10)
140 IF k=90 OR k=122 THEN
    A$="LEFT"
150 IF k=88 OR k=120 THEN
    A$="RIGHT"
160 IF k=58 THEN A$="UP"
170 IF k=47 THEN A$="DOWN"
315 *FX15,0
316 *FX11,0
```

The second problem is caused at lines 970, 1000 and 1060 where there are jumps out of a procedure right back to the outer level of the program.

The problem in this program is solved by restructuring. First delete lines 980-1000 and make the following changes:

```
  90 REPEAT:MORE=TRUE
 270 UNTIL MORE
 970 LIVE=LIVE-1:
     MORE=FALSE:ENDPROC
1060 PROCWAIT(5000):SCREEN%=
     SCREEN%+1:MORE=
     FALSE:ENDPROC
  35 REPEAT
  55 REPEAT
 271 UNTIL LIVE<0
 272 ON ERROR GOTO 1400
 273 *FX15,0
 274 VDU17,0,30:PRINT
     "DEAD",',"Press SPACE BAR
     to continue",',"ESCAPE to
     terminate"
 275 REPEAT:UNTIL GET=32
 276 ON ERROR GOTO 30
 277 UNTIL FALSE
1400 MODE 7:*FX11,50
1410 END
```

I also found it desirable to display the scores while waiting for the next screen by including the statement Procdisplay in line 70.

F T Bell,
Malvern,
Worcestershire.

EDITORIAL

BREAK IT TO THEM GENTLY. You should make sure newcomers to computing are seated before you tell them that although home micros may seem the same to the outsider — same small plastic case, same claims to electronic wizardry — each model is very different. So different, in fact, that software written for one machine will never run on another.

Despite the fact that a pop single would never be a hit if it could only be played on only one type of record player, software incompatibility seems acceptable to the home-computer industry. Why should this be the case?

At first sight the idiosyncrasies of each computer appear to be the stumbling block. Different micros do different jobs and with varying degrees of efficiency. Because the BBC Micro has a sound synthesiser, special commands are needed to handle it. So even if the ZX-81 used the same central processor and the same Basic as the BBC computer, there would be large chunks of the BBC's programs which would mean nothing to Sinclair's mute machine. But these differences in hardware need not rule out portability of programs between micros. Had the financial rewards been high enough that problem could have been solved by now. The fact is the micro-makers do not want portability.

The whole idea of pushing a micro into the home mass-market is to sell a lot of units. If a machine is a success, big sales of software will follow — preferably the micro manufacturer's own brand. In some cases the fact that an outstandingly good program is available on one micro only can become a strong selling point in the machine's favour. Regardless of whether or not that program comes from an independent software house, the last thing the micro's manufacturer will want is for the program to become widely available on other machines.

A degree of standardisation does exist in business computing. Digital Research developed the operating system CP/M which does at least ensure portability of software between certain Z-80-based micros. But what is expedient in the business market is not necessarily important for home computing.

Home users are interested in computing for itself — for the things one can do with computers. Business users' interest lies in computers as tools. Where a home-computer user might write a game after work, the business owner is unlikely to want to, or be able to, knock up a database management package over the weekend. The business fraternity need access to a wide choice of highly complex software, so portability is more important.

There is, however, a new twist. A recent survey conducted by IBM in the States showed that 60 percent of IBM Personal Computers are being used in the home. Until now home computing has meant low-cost computing. If it comes to include business computing at home, then software standardisation will become important and profitable.

Last month French company Cyborg's plans to tackle the portability problem were revealed in *Your Computer*. Now Digital Research has announced a graphics software system which could have wide implications for home computing. Any graphics display created using this system will run on any other micro that can support it.

If producing more than a million home micros earned Clive Sinclair a knighthood in the Birthday Honours then surely the first man to break the software barrier will be in line for a hereditary peerage.

How to write for *Your Computer*

We called this magazine *Your Computer* precisely because we welcome your views, tips and hints and even your criticism of machines and software in general. If you would like to see your name in print, whether on a Software File program or a full-blooded article, here is how to go about it. Ideally, all articles should be typed double-spaced on one side only of uniform sheets of paper. If listings can be dumped directly from a printer — you can always use a friend's or user group's — this minimises the risk of error. In a perfect world a cassette would accompany the article. That considerably speeds up the checking process. Not only do you get to air your own discoveries and opinions, but we will even pay you for the privilege. We pay £35 per published page — that's as it appears in the magazine and includes illustrations.

Why not give it a try? You have nothing to lose but your postage.

Wanted: We want program checkers to assess readers' programs. If you can help us please write to Simon Beesley, *Your Computer,* stating which machine you have expertise on.

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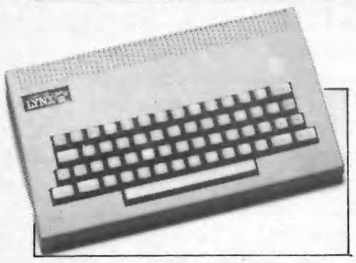

Lynx big cat bounces back

NOW YOU SEE IT, now you don't. Camputers finally launched the 96K version of the Lynx for £299 at our Earl's Court Computer Fair. But only 37.5K of the total memory is available to the user for Basic programs. An additional 24K is available for machine code. The screen and operating system make heavy demands on the Lynx's RAM and leave the user with just 13.5K on the 48K model.

It is not possible at present to run a printer from the 48K Lynx but Camputers have have included the necessary software in the 96K's expanded ROM and will be supplying it free on cassette to 48K owners. This will allow printer with RS-232 interfaces to be driven from the Lynx's serial port but owners who want to use a parallel interface will need to spend a further £49.95 on Camputers is also offering to upgrade 48K machines to 96K for £90.

YOUR COMPUTER TOP 20

Game	Company	Machine
Ah Diddums	Imagine	Spectrum
Black Crystal	Carnell Software	ZX-81
Bonka	J Morrison	Dragon
Boss	Audiogenic	Vic-20
Donkey King	Microdeal	Dragon
Flight Simulator	Psion	Spectrum
Flight Simulator	Psion	ZX-81
High Resolution	Computer Rentalls	ZX-81
Hobbit	Melbourne House	Spectrum
Jet Pac	Ultimate Play The Game	Spectrum
Killer Gorilla	Program Power	BBC
M. Coder	PSS	ZX-81
Matrix	Llamasoft	Vic-20
Miner 2049er	Big Five Software	Atari
Moon Raider	Program Power	BBC
Penetrator	Melbourne House	Spectrum
Q S Scramble	Quicksilva	ZX-81
Rocket Raid	Acornsoft	BBC
Wacky Waiters	Imagine	Vic-20
Zaxxon	Datasoft	Atari

Laser and Comx rising in the East as pre-launch prices go West.

EVEN MORE remarkable than the £70 price tag of the Laser colour computer or the built-in joystick of the Comx 35 is the fact that the distributor, Moiranbrook, has cut both their prices before they have even been launched.

The Laser 200 is none other than the Texet TX-8000 reviewed in April *Your Computer* and now to be sold for £30 less at £69.95. It comes with 4K RAM but when it goes on sale next month a 16K RAM pack will be available for £29.95.

The Comx 35 was advertised last month for £149.95, but Moiranbrook has now reduced the price to £119.95. Based on the 1802A processor it offers a full-size keyboard, 35K RAM and a built-in joystick.

There are no pixel plotting commands in the machine's Basic but as on the Vic the entire character set can be redefined to give a pixel resolution of 240 by 216. Other features include a single sound channel and a choice of eight foreground and eight background colours.

Both computers will be in the shops next month. Details of the Comx 35 and Laser are available from Moiranbrook Ltd., 30 Hornsby Square, Southfields Park, Laindon, Basildon, Essex. Telephone 0268 418414.

BBC takes the Hitachi microfloppy for a spin

SINCE HITACHI and Sony released their microfloppy disc drives last year companies have been racing to adapt them for home computing. Now Advanced Memory Systems has produced a 3in. disc system for the BBC Microcomputer using the Hitachi drive.

The drives which are cased in rigid steel cost £225 and £399 for the single and double version. Included in the price are a manual, cables, a utility disc and an EPROM containing the formatting program which plugs in to one of the BBC's ROM sockets.

At £4.95 each the 3in. double-sided discs are more expensive than the normal 5.25in. floppy discs but have the advantage of being totally enclosed in rigid plastic with no exposed surfaces. At present these products are only available by mail order from Advanced Memory Services, Woodside Technology Centre, Green Lane, Appleton, Warrington.

Beeb-Ex may look like the latest automatic vegetable slicer but in fact it is an interface card which connects to the BBC Micro's 1 MHz bus port and is designed to expand the BBC's I/O facilities. It takes up to four Eurocards from a range of 30 offering such facilities as 8 or 12-bit analogue interfaces, additional independent video outputs, and extra memory. 256 bytes of memory can be addressed directly and up to 1 Mbyte in page mode. Beeb-Ex costs £49 from Control Universal Unit 2, Anderson's Court, Newnham Road, Cambridge.

Pacy compiler Mcodes faster

DAVID THRELFALL, whose series on his ZX-81 compiler Mcoder starts in this month's issue, has now written improved versions for the ZX-81 and Spectrum. The new compiler, Mcoder 2, is unique among Sinclair compilers in allowing for string variables and string splicing. It also provides for up to 26 arrays. Programs compiled by Mcoder 2 run around 50 times faster. Mcoder 2 is available from PSS, 452 Stoney Stanton Road, Coventry CV6 5DG, and costs £9.95 for the Spectrum and £8.95 for the ZX-81.

Bank manager in the wardrobe

HOME COMPUTER ADDICTS can now conduct their financial transactions without dragging themselves away from the keyboard. Under Nottingham Building Society's Home Link scheme account-holders will be able to run their accounts from home by linking up to the building society's computer via the Prestel network.

The catch is that the scheme only applies to people with savings of £1,000 or over. If you already own a computer and you are willing to invest this sum the building society will supply you with a Prestel adaptor for 12½p a week. If you do not own a computer the company will provide a 16K Spectrum together with the Micronet Prestel adaptor for 50p a week.

The scheme offers account holders such facilities as using the computer to check their balance, pay their bills and engage in discount tele-shopping. There will be monthly competitions with substantial prizes and an annual prize of £50,000.

The Bank of Scotland is also tied in to the Home Link scheme so it will be possible to transfer funds between building society and bank savings accounts.

From Penzance to Aberdeen Tandy dealers await the MC-10

TANDY IS BACK in the bargain basement of home computing with a sub-£100 colour computer called the MC-10.

The 4K MC-10 will be in the shops from October together with an optional 16K RAM pack. The machine is based on a 6803 CPU and has a built-in serial port for a printer. The click keyboard will accept single-key entry or allow you to type out commands in full.

Until the MC-10 arrives Tandy dealers will have to keep trying to sell the Tandy Colour Computer — which has been difficult since the Dragon was launched. Effectively the Dragon is a Tandy look-alike inside with a better keyboard outside.

As the 32K Dragon now costs just £175 while the 16K Tandy costs £240, selling Tandys in Britain is a struggle. Tandy is not planning to discontinue the Colour Computer yet but price cuts are likely soon and work on a replacement continues behind Tandy's closed doors.

The company's great advantage over its rivals is the after-sales support it can offer through 350 Tandy shops stretching from Penzance to Aberdeen.

Oric Products has promised to support the Oric with a full range of peripherals. The first of these has now arrived — a four colour printer/plotter which sells for £169.95 complete with connecting lead. It uses the same ball pen mechanism as the Tandy printer and the printer for the MZ-700 reviewed in this issue. 40 or 80 characters can be printed per line in text mode, while the graphics mode provides a variety of plotting commands. Print speed is 12 characters on 4.5in. plain paper. The Oric printer comes with a standard Centronics interface and can thus be used by any other micro with a parallel printer.

Pilot a flight from reality with Harrier take-off for the Oric

HARRIER ATTACK will soon allow war-games enthusiasts to put away their toy guns and cap pistols and take to the skies at the controls of an Oric. This £6.95 game from Martech Durell allows you to take off from the deck of a carrier navigate your way to a target, fending off hostile aircraft, and bomb the enemy base. The only option it does not leave you is crash-landing your plane on a ship in mid-Atlantic.

Up till now Martech has been better known for computer-moderated board games like Conflict and Galaxy Conflict but now it is also producing arcade-style games like Harrier Attack for the Oric and Jungle Trouble for the Spectrum. Conflict and Galaxy Conflict are strategic war games for two players. You plot your progress on a board while the computer sets up new military scenarios.

The war games have been available on the Spectrum for several months and are now being released in versions for the Atari 800, Commodore 64, BBC B and Dragon 32. Martech is on 0323 642719.

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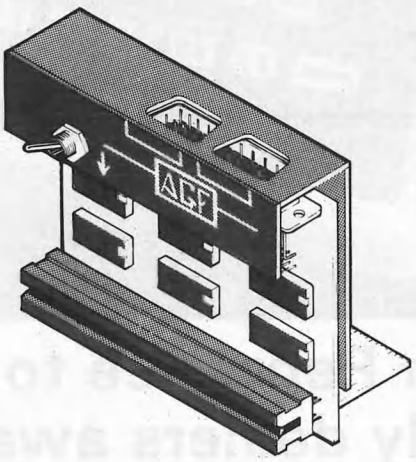

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INTERFACE II COMPATIBLE SOFTWARE

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	*	Invasion
	*	Harrier
	*	Cosmos
	*	The Android Run
	*	High Noon
	*	ETX
Abersoft		Mazeman
		The Wizards
		Warriors
Apocolypse Software		Galactic Jailbreak
Axis		Labyrinth
Campbell Systems		Gulpman
CDS Micro Systems		Leapfrog
C. Tech		Specman
D. J. L. Software		Froggy
DK 'Tronics	☐	3D Tanx £4.95
		Meteoroids
Hewson Consultants		Nightflite
		Specvaders
		Mazechase
ICL		Star Trail (Man.Dock)
Imagine		Zzoom
Micromania		Ghost's Revenge
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	☐	3D Tunnel £5.95
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	Froggy
Hewson Consultants	Pilot
	Puckman
New Generation Software	3D Monster Maze
	1K Breakout
Newsoft Products	Time Bandits
P.S.S.	Krazy Kong
	Ghost Hunt
	Maze Drag Race
Psion	Bomber
Quicksilva	QS Invaders
	Scramble
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	* Super Scramble
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	SOFTWARE AS TICKED ON LIST		
	SOFTWARE AS TICKED ON LIST		
ZX81 ☐	ZX SPECTRUM ☐ Please tick	FINAL TOTAL	

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Computer Club is here to encourage you to start your own local computer club or, if one already exists, to join it and become involved. We would like to hear of anything which has made your club a success, or of any projects or programs you are developing.

The lowdown on Biggin Hill

WITH A BASE at Biggin Hill, the home of Fighter Command during the Battle of Britain, you might expect the North Kent Amateur Computer Club to concentrate on flight simulations and aerial combat programs.

But when *Your Computer* visited NKACC — held at Biggin Hill memorial library during the school holidays — the evening was dedicated to the serious business of Prestel, especially to that system's magic circle for home computer users, Micronet 800.

The good news was brought by Dr David Annals, secretary of the Association of Computer Clubs. Also bearing witness were Barry Biddles, editor of the Independent Commodore Products User Group South-East magazine, and Tom Cranston likewise of ICPUG. The south-east branch of this particular organisation has been going for nearly five years, so it is no surprise that its membership of around 300 somewhat dwarfs the nascent NKACC's 60 members.

However small the NKACC may be, it is clear that they are keen to be involved in as many projects as possible.

An impressive array of equipment was set up to illustrate the lecture, including a Pet CBM, a colour TV monitor, a Tantel modem, and a black-and-white Reuters monitor. Prestel is an information-only system operated by British Telecom. Its format is the same as a viewdata system like Ceefax or Oracle. The essential difference lies in the telephone line. "The Prestel computer can display a vast number of frames much more quickly than its competitors which do not have the advantage of the telephone line" said Dr Annals.

In the heart of the rural English scene, Paul Bond discovers North Kent Amateur Computer Club is joining the network.

This speed advantage means faster access to its data base. Prestel computers are not, as yet, accessible all over the country, however, this did not affeect NKACC members who could count themselves lucky that most Prestel computers were based in Croydon. The main editorial computer is called Duke, and Enterprise is the mailbox machine — but the other computers have a rather more literary lineage: Hogarth, Keats and Dickens being among their noms de plume.

Having given us a basic idea of what Prestel was about, Dr Annals moved on to the interactive facility open to members who pay to become part of Micronet. Whether your modem is hardwired or acoustic, the 25 by 40 format of the Pet fits nicely into the Prestel format. Other machines like the BBC have to adapt. The ACC secretary demonstrated the interface by summoning the Enterprise.

Top picture: Kevin Viney and Micronet hardware. Above: David Annals and Tom Cranston do some pre-flight checks.

There are 100 different programs for at least four machines provided by every member user group. The clubs are required not only to provide the programs, but also to maintain them. At least 10 percent of new programs have to be added every month. To this end regular seminars are being held to train people as Prestel editors. Two editors' conferences have already been held. Once admitted to this elite you can do things like unburden yourself in the viewdata magazine's Poet's Corner as this manic downloader did:

"For most programs I have no need, to duplicate I must succeed; It's not that I'm consumed by greed, my honesty is guaranteed; To all you writers I'm no threat, 'cos I observe an etiquette; I am a software paragon, I'll not pass your program on."

Usually, the Biggin Hill club's meetings are rather informal. Meetings are held every Thursday. For further details contact Ian House on 01-690 5441.

Local society news

Edinburgh branches out

FROM BEING a club devoted to the ZX-81 the Edinburgh Home Computing Club has branched out and now seeks to cater for all home computers. It meets on the second, third and fourth Wednesdays of each month at the Claremont Hotel, Edinburgh. Future plans include putting out a bi-monthly newsletter and hardware and software workshops. Anyone interested can contact John Palmer on 031-661 3183 or Iain Robertson on 031-4412361.

Tameside technocrats

TAMESIDE Computer Club meets on the first Tuesday of every month at the Co-Operative Society Hall on Market Street, Hyde. The club has a technical section and is also planning to write and market its own software. Contact Terence Batty on 061-3665935 for further information.

Computing in Cheshire

THE MID-CHESHIRE Computer Club meets every second Friday at the main Winsford library in the town centre. Meetings are varied in content and include courses for beginners. In July the club holds its own Computer Olympics — a fun evening for members and the community. For details ring Simon Sadler on Winsford 53339.

Renfrew micros

COMPUTERNIKS in the Renfrewshire area can attend meetings of the Bishopton Computer Club. The club meets monthly on Sunday afternoons at Cwa Ben, Sachelcourt Avenue, Bishopton. Most of the range of popular home computers are on show at meetings, from the ZX-81 to the BBC Micro. Anyone is welcome to go along whether they own a computer of not. For more details contact Alasdair Law on Bishopton 3137.

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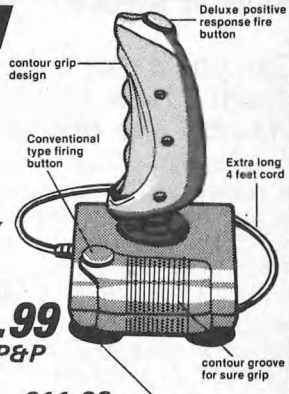

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QUESTIONS

What are arrays for?

'Can you explain arrays to me clearly? How and when should I use them?'

A SIMPLE numeric variable can only contain one number and therefore you might think that if you want to store lots of numbers you must have lots of simple variables, with different names. As often only single letters can be used as variable names, this would seem to limit you to the letters A to Z, and hence to 26 variables. This is obviously not much use if you want to store lots of information, so most dialects of Basic also give an array facility. This allows you to use the same letter to describe a number of different variables. Exactly how arrays are dealt with varies with the dialect but these are the general principles.

If you think of a simple variable A as a box in which you can store a number, then think of an array A as a pile of boxes called A. To define each box in this pile separately you now need to be able to indicate where in the pile that particular box lies. To do that you number them by adding a "subscript" and calling them A(0), A(1), A(3) etc. What you have now is a "single-dimensional array". To go back to our box model think what would happen if you put another pile of boxes — still called A — behind the first pile. To define a particular box you would now need to specify which pile it was in, and then which position in that pile it occupied. To be able to do that you would obviously need two subscripts, one to specify the pile, and one to specify the position in the pile, so boxes are named as A(0,1), A(1,1) etc.

If we now make another two piles of boxes to the left of our existing piles — still calling them A — we need three subscripts, and call boxes A(0,1,1) etc. The box model breaks down at this point, as we cannot draw in more than three dimensions, but as in the computer we do not really have boxes but "array elements" you can actually often make arrays with four or more dimensions.

Obviously all these array elements are going to take up more memory than simple variables, as each element has to be labelled so that it is recognised as different by the system. It is usually necessary to reserve memory space for arrays by Dimensioning them. When you Dim an array you must tell the computer how many elements you want, and how you want them arranged. For example

DIM A(10,5)

is equivalent to "reserve space for 10 piles, each containing 5 boxes".

When you want to put something into a particular element you just name it with all its subscripts, for example, A(0,1,1) = 128
and to get something back just read it in the same way X = A(0,1,1)

String arrays are like simple arrays, except that they have "depth" built in so that they can contain a whole list of numbers. As each of these numbers can represent a character you can store whole words. String arrays may be of "fixed" or "variable" length. In a fixed length array, all the strings are the same length. This is really a disguised simple array with an extra dimension. This can be very wasteful if some of the words you want to store are longer than others, as the empty space will still be reserved in memory. A variable length array is much better as it has "elastic" array elements which expand automatically so that the string you enter just fits. The length of each element in a string array is limited to 255 as the length of the string must be stored in one byte.

Keith and Steven Brain

SPAC

WHEN YOU have spent a long time writing a program it can be a frustrating experience to find that it will not fit into the available memory. Usually this only becomes apparent when you run the program and discover that although the program text fits in there is not

ON RESO

ALL THE DIFFERENT microcomputer manufacturers make claims about the resolution available on their particular machine, but what does this mean in practice?

Start by thinking about the normal text screen where alphanumeric characters are displayed. The number of characters which can be displayed varies according to the system but usually consists of 16-40 characters per line, with 16-24 lines per screen giving between 256 and 960 characters on the screen.

Each of these character positions can show any of the available characters. The characters available may be totally pre-programmed in ROM, or the video generator chip, or some of them may be user-programmable in RAM. Instead of showing an alphanumeric character each position may often be set to a particular colour instead.

The next stage is low-resolution pixel graphics where each position is divided up into a number of individual pixels — picture elements — which can be controlled separately — normally there are four or six units.

Finally we have true high-resolution where even more points can be addressed individually. The resolution is expressed by giving the number of points on the X and Y axes which can be controlled separately. Fox example, 128×192=24576 points. As the number of points to be controlled increases, so does the memory required to support this.

If we take the simplest case where a point can only be on or off, and we represent each point by one of the eight bits of a byte, then 24576 points will need 24576 over eight bytes: that is, 3K. When we want to be able to set each point to a different colour then the memory requirement increases rapidly. If we take bits in pairs, instead of individually, then we can have four different colours represented as follows, but need 6K of memory.

E SAVING

enough room for its variables. Up comes the message "Out of memory" or, simply, on the BBC Micro "No room".

This is a common problem, particularly on micros where the screen memory consumes a large portion of RAM.

After the screen memory and the operating system have taken their share, in high-resolution modes, the user is only left with 8.5K on the 32K BBC model B; while on the Lynx the screen takes 32 of the 48K RAM. Lack of memory can also be a problem on the Spectrum and Oric where 6K and 8K respectively are given over to the screen memory.

In many cases the program turns out to be only a few hundred bytes over the limit and it is usually possible to trim it to the required length.

One way of doing this is to redesign the program. It is clearly wasteful to have several different parts of the program performing the same function. You can save a lot of space by ensuring that each distinct program function is handled by one subroutine. This also happens to be good programming practise.

On a smaller scale you can cut the program length by putting as many statements as possible on one line. Most micros limit the length of a program line to 255 characters but on the Spectrum a single program line can be much longer.

If you adopt this technique be careful where you place your If-Then statements. Remember that if the condition in an If-Then statement is not satisfied, control passes to the next line and not the rest of the same line.

Arrays can consume large tracts of memory and it is sometimes more economical to Poke and Peek data to and from an area of memory outside the Basic program area.

On some micros the operating system reserves certain parts of RAM for its own purposes — as a cassette buffer or to store user-defined character definitions. If these are not in use you claim them for your own storage areas. The space from 828 to 1019 on the Vic, for example, is set aside for reading-in cassette data files, while BBC programs can sometimes make use of the RAM running from &900 to &E00. An alternative method of reserving storage space is to lower the top of the Basic program area — RAMtop on Sinclair machines — and use the free space above.

The limitations to this technique are that you can only store integers in the range 0-255. There are many other ways of saving space but most of them rely on each micro's particular quirks. In future First Bytes, we will give some tips on how to exploit these quirks.

OLUTION

	bit 1	bit 2
Colour 1	on	on
Colour 2	on	off
Colour 3	off	on
Colour 4	off	off

If we alternatively look at bits in fours we can cope with 16 different colours but we now need 12K of memory for that 128×192 resolution.

	bit 1	bit 2	bit 3	bit 4
Colour 1	on	on	on	on
Colour 2	on	on	on	off
Colour 3	on	on	off	on
Colour 4	on	off	on	on
Colour 5	off	on	on	on
Colour 6	on	on	off	off
Colour 7	on	off	off	on
Colour 8	off	off	on	on
Colour 9	on	off	on	off
Colour 10	off	on	off	on
Colour 11	off	on	on	off
Colour 12	on	off	off	off
Colour 13	off	off	off	on
Colour 14	off	on	off	off
Colour 15	off	off	on	off
Colour 16	off	off	off	off

Although you can have 16 colours in this way you could alternatively have fewer colours and use some of the other bits to store other information such as intensity, flashing, or background/foreground.

Some systems make some memory savings by restricting the number of different attributes which you can use in a given area. For example you may not be able to set all adjacent points to different colours.

Most systems give you a choice of hi-res modes with different numbers of colours and addressable points but you must always remember that the more complicated your requirements the more memory you will use, and that it is not usually the total memory capacity of the machine which is important but the amount left after setting up the hi-res graphics.

Keith and Steven Brain

I could do that...

Most micros have a pseudo-random number generator, which produces a series of numbers which lie between 0 and 1. They are supposed to be random: but are they? There are many algorithms in use — for instance, on one of our machines the RND function takes an integer — the seed — and multiples it by another integer roughly equal to the square root of the largest number that can be stored in one word in the micro. If the result is too big to fit, it is just allowed to overflow, and just the most significant part is kept. This is the seed the next time RND is used. The number is then normalised — multiplied by a suitably small number so that all the results lie between 0 and 1 — or whatever the range required. Now to the question: write a program to check the spread of a reasonably large quantity of random numbers produced on your machine, displaying the results as a histogram or graph on the screen. Do different ranges produce different results?

The £15 prize for May's Armstrong numbers competition goes to N. Webb, 3 Forest Close, Highcliffe, Dorset. His program was similar to many others and is probably the shortest possible solution, although not the quickest.

```
10 FOR N = 1 TO 5000
20 C = 0
30 B$ = STR$(N)
40 FOR X = 1 TO LEN(B$)
50 A = VAL(MID$(B$,X,1))
60 C = C + (A*A*A)
70 NEXT
80 IF C = N THEN PRINT N
90 NEXT
```

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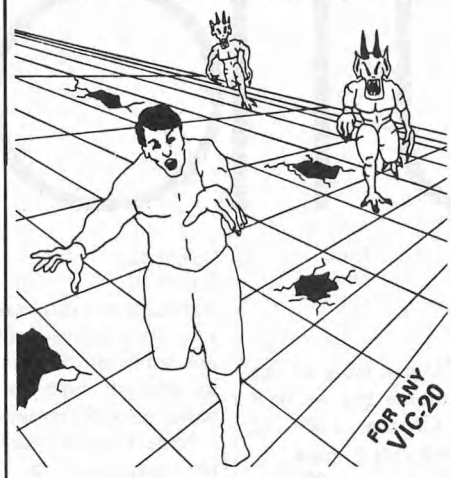

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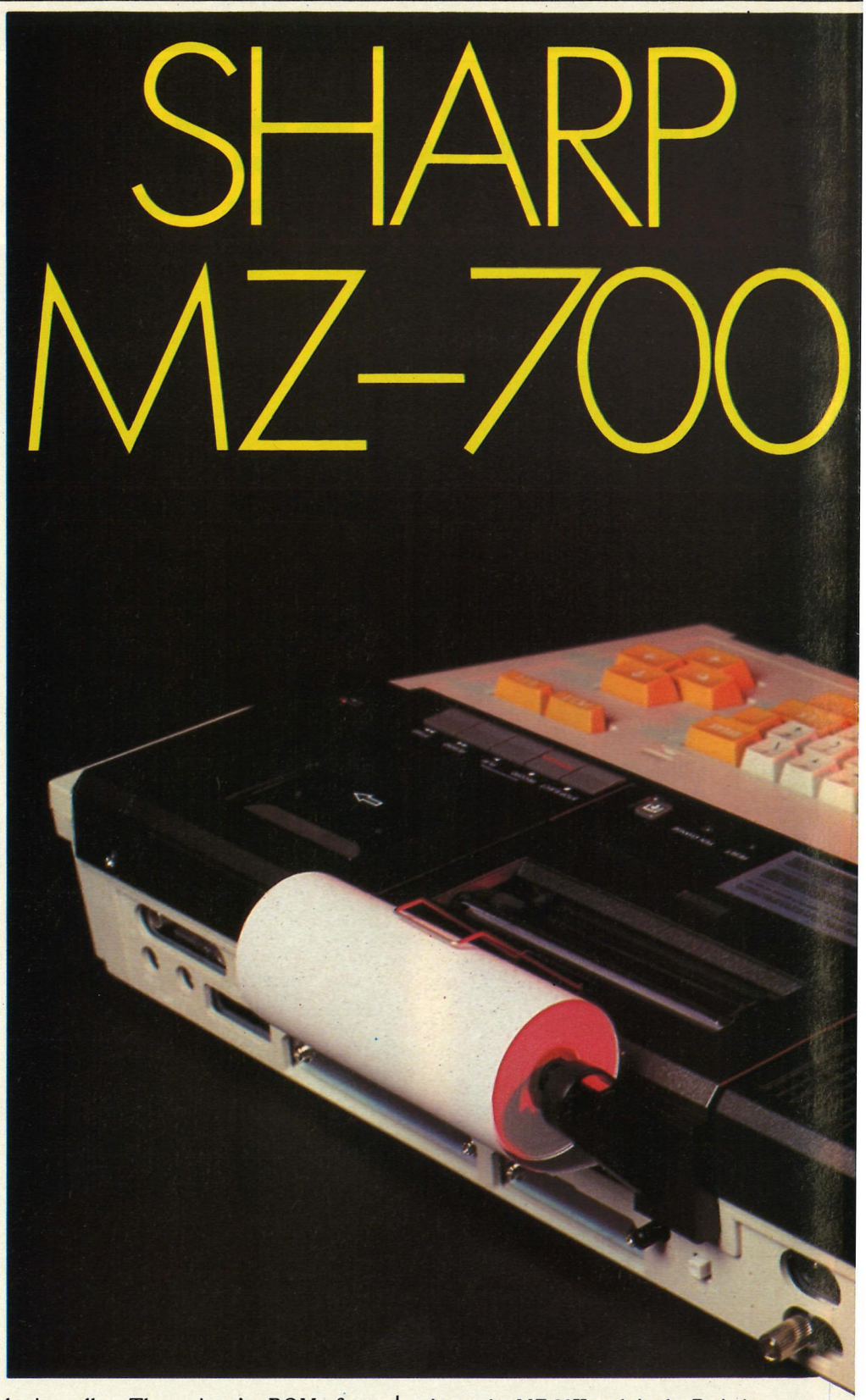
SHARP MZ-700



COMPETITION WAS thin when the Japanese company Sharp released the MZ-80K in 1979, and for a while the machine was one of the top-sellers in the home-micro market. Sharp followed it up in 1982 with the MZ-80A, which was seen as being little more than a revamped version of the K.

The design was substantially the same and Sharp had not corrected the shortcomings that were beginning to make it look antiquated. Essentially these were a lack of high-resolution graphics, and the absence of a resident Basic. It has now been largely superseded by cheaper and more sophisticated British micros.

In September Sharp will launch the MZ-700 — its latest bid to re-enter the home computer market. It has been selling well in Japan for the past seven months. Could it be a contender over here?

Sharp will be selling the MZ-700 in two versions — with and without an integrated printer/plotter and cassette drive. In the integrated version which costs £420 the printer/plotter and cassette unit fit into two compartments behind the keyboard.

It will be possible to buy each separately at a price of £130 for the printer/plotter and £40 for the 1,200 baud cassette drive. The stand-alone machine costs £250.

The appearance and construction of the MZ-700 are highly impressive — they make most British micros look distinctly tacky by comparison. With the printer/plotter and the cassette recorder in place it looks typical of many other high quality Japanese products.

The keyboard has a solid and springy feel. Five function keys are set above it and can be assigned commands from Basic in the same way that the BBC Micro's function keys be defined. The cursor keys are grouped together in a separate keypad and above them are the delete and insert keys which can be used with the shift key to clear the screen or home the cursor.

These and other well-finished details such as a power-on light combine to make the MZ-700 look more like a smart desk-top office machine than a home computer.

At the back of the console are a full array of ports together with an on/off switch and a reset button. As well as a PAL output socket there are sockets for RGB and composite-video monitors.

Read and write sockets enable you to use an ordinary cassette recorder instead of the Sharp's dedicated one, and the printer port likewise allows the MZ-80A printer to be used as an alternative to the printer/plotter.

Also at the back are two joystick ports and an I/O bus. Devices such as a floppy drive or a music synthesiser can be connected to the I/O bus through an optional universal interface board.

The printer uses the same mechanism as the Tandy printer glowingly reviewed in *Your Computer* March 1983. This runs on any computer with a Centronics or RS-232 interface, and has been snapped up by owners wherever it is available.

It is a remarkably ingenious device which uses four ink pens to write or draw on plain paper in four colours. Vertical strokes are formed by moving the paper up and down against the pen while the pen only moves horizontally. The printer's ROM forms characters by co-ordinating the two movements.

Although the paper is only 4.5in. wide, even at 80 characters per line text printing is very clear — certainly it as a clearer printout than could be achieved by a dot-matrix printer.

So far promising enough. But does the rest of the system match up to its attractive exterior? Sharp describe the MZ-700 as a "clean machine". Clean is a curious and rather inappropriate gloss on the fact that there is no resident Basic in ROM.

As on the MZ-80K and A, the Basic interpreter must be loaded in from tape. Sharp argues that the advantage of this is that you can easily run languages other than Basic.

This advantage does not really count against the nuisance of having to wait three minutes to load Basic. It is not much more difficult to run languages like Forth or Pascal on the Spectrum, for example, although admittedly they cannot occupy the same memory area as the resident Basic.

A far better system is the BBC Micro's which allows different ROMs to be paged in

REVIEW

Sharp's smart new MZ-700 offers 64K of RAM, built-in colour printer and cassette recorder all for just over £400. Simon Beesley finds out whether taking the music-centre approach to home computing really works.

and out of the same memory space. On the BBC Micro a number of different languages can be resident at the same time and all can be instantly available.

Clean in this context effectively means empty. On power-up the user is presented with 64K RAM and a 4K monitor in ROM. In addition there is 4K video RAM and 4K ROM for the character generator. The monitor which performs such operating-system functions as reading the keyboard and writing to controlling the display, loads in the Basic interpreter to leave 36,567 bytes free for programs.

Colour and graphics are two areas in which the recent batch of micros has overtaken the MZ-80A. The MZ-700 improves the MZ-80A by offering eight colours but the machine's graphics are as poor as its predecessor's. It offers a mere 80-by-50 pixel resolution.

This is not a true high-resolution facility but simply an extension of the normal text display. The code for each character on the screen is stored in the video RAM. Each pixel occupies a quarter of a normal character space and the code for a single pixel — or a configuration of pixels within one character space — is stored in the same way as any other character.

The text display offers 40 columns by 25 lines in upper and lower case. As the screen display takes up only 1K of the video RAM, it acts as a window on a larger display and can be scrolled up and down over the 2K area. The remaining 2K of the video RAM is used to store the colour attributes for screen characters and allows the background and foreground of a single character space to be specified in one of the eight colours.

At a time when you can buy a home computer for less than £100 with 256-by-192 pixel resolution, the MZ-700's lack of high-resolution graphics is a major shortcoming. As part compensation the machine provides a large set of predefined graphic characters.

Pressing the graphics key switches the keyboard from alphanumeric mode and allows you to print the graphic characters which are shown on the front faces of the keys. There is also an alternative character set which gives a choice of a further 256 characters.

Such a wide selection of predefined graphics certainly gives scope for building up reasonably detailed pictures on the screen. but it is a pity the machine does not also provide for user-defined characters.

This feature, which is now almost standard on British and American micros, can stand in place of a separate high-resolution mode. Anyone who has seen some of the recent games for the Vic-20 will be impressed by the

(continued on page 55)

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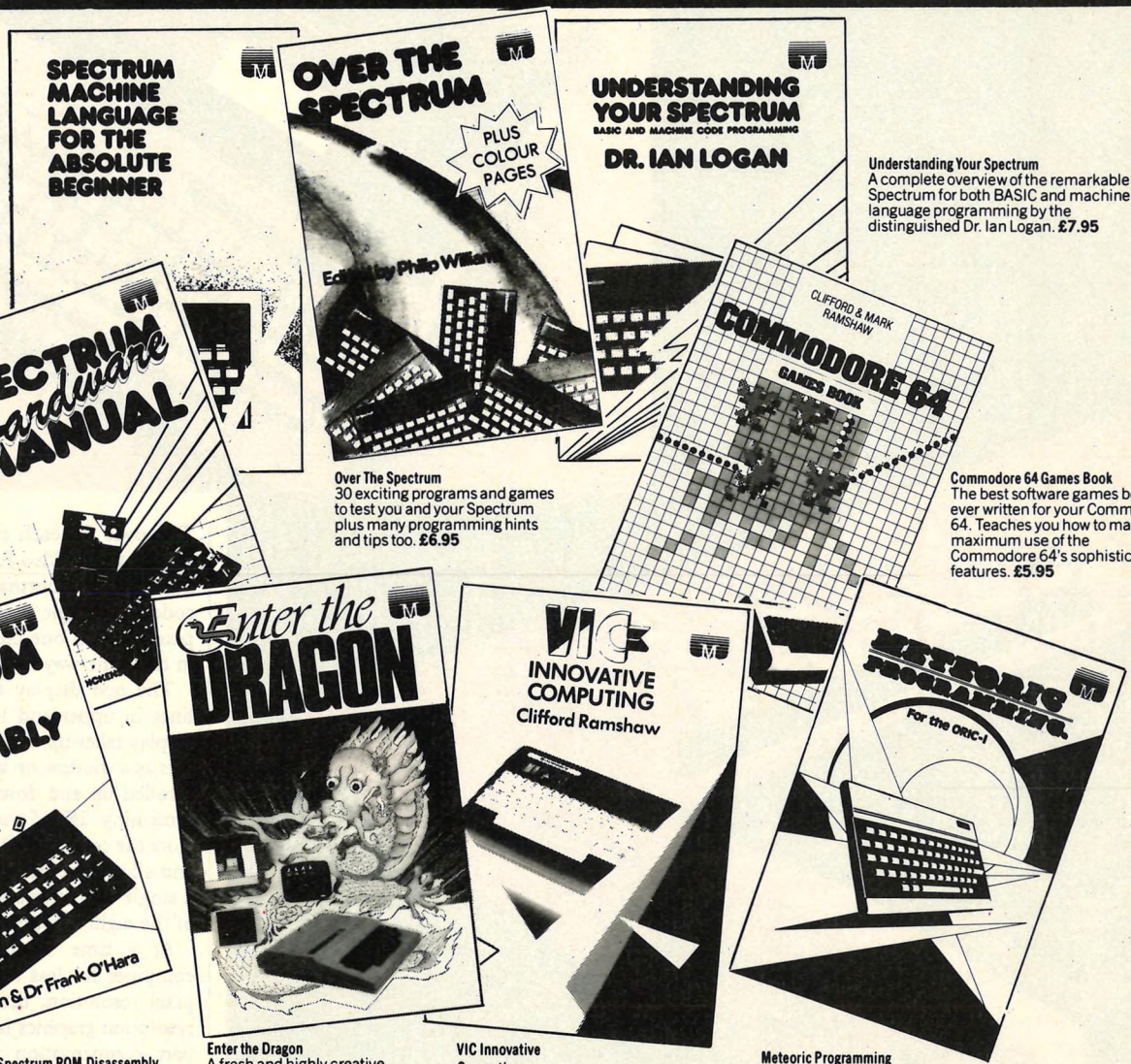

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(continued from page 53)
high-resolution graphics which are achieved by manipulating the character definitions.

Most of the features mentioned so far are present on the MZ-80A. Sharp has upgraded the new machine's processor to a Z-80A with a fast clock rate at 3MH but otherwise it seems as if Sharp has done little more than embellish an already outmoded system. This impression is confirmed by a look at MZ-700's Basic.

By and large the Basic is the MZ-80A's, but substantially extended by a set of printer commands and several other new utilities.

Colour is set by the Color statement followed by four parameters which determine the foreground and background colours of either the whole screen or particular characters. This is rather easier to use than equivalent colour control statements in Sinclair or Commodore Basic.

The commands Set and Reset are the Sharp Basic's only concession to graphics, and respectively plot and unplot pixels.

Renumber and Delete are useful additions to the text-editing commands, as is Merge which joins another program to the existing program file. Other unusual features include the error trapping command On Error, If-Ern and If-Erl. Size gives the number of bytes free and Limit is used to lower the top of the Basic program area.

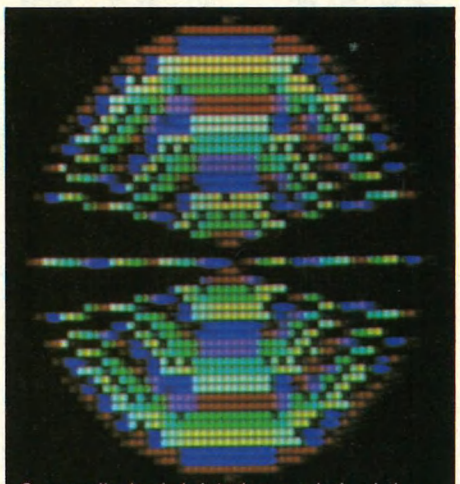
What one might have hoped for in the way of graphics commands are provided instead for the printer/plotter. Although the Tandy printer can draw lines, axes and circles, it requires a cumbersome string of control codes to do so. With Sharp's printer, the software makes these facilities much more accessible and effectively means you can treat the printer as one would a high-resolution screen.

You can move the pen with or without drawing to any point in the print area as specified by x and y co-ordinates. The x-axis scale extends across the paper from —240 to 240, while the y-axis stretches over 12in. up and down the paper on a scale from 999 to -999. Axis x can be used to draw and mark off the axes and HSet resets the origin.

There are commands to draw lines either relatively to the current pen location or in terms of absolute co-ordinates. By setting parameters you can draw a circle of any radius and arc length from any given centre.

In addition to the graphics plotting mode there are three text modes for printing at 26, 40 or 80 characters to the line. Characters can also be printed upside down or at right angles to the line. PColor selects the pen colour in both graphic and text modes.

These printer commands redeem the MZ-700 Basic from being fatally dull. To some extent the facilities they supply serve as an adequate substitute for high-resolution graphics. Indeed the Plot On command enables the screen to be dispensed with by sending all keyboard input directly to the printer. At 12 characters per second, the print speed is fairly slow but fast enough, at least, for two-finger typists.


Screen display is bright but resolution is low.

Otherwise the MZ-700 Basic does not differ greatly from any other Microsoft-derived Basic such as the Dragon's. All the standard string-handling commands and arithmetic functions are there. Print Tab is supplemented by Cursor which places the cursor at any point and Print Using for formatting screen output.

The MZ-700 has a single sound channel that issues an electronic organ-style sound through quite a powerful internal speaker. Volume can be adjusted by a control switch at the back of the computer. The tone, octave and length of notes are entered as string parameters to the Music statement while Tempo sets the tempo.

All in all, Sharp Basic is no better and no worse than most of the other versions of the language at this end of the market. And running a set of standard test programs on it showed that it was faster than most — faster in fact than any other home computer Basic except for BBC Basic.

Nonetheless Sharp could have developed the language in a more exciting direction. The inclusion of If-Then-Else, procedures or Repeat-Until would have done a lot to pep up this latest version.

Editing Basic programs is made easy by a full screen editor — the same as that found on Commodore machines. You can move the cursor to modify a line at any part of the screen. A screen editor like this is greatly preferable to the Sinclair or Dragon editors which require you to pull a line down to the bottom before editing it.

One of the advantages of having Basic on cassette is that the entire 64K RAM can be used for machine-code programs. The Basic interpreter includes a machine-code monitor which further encourages machine code programming on the MZ-700.

It includes commands to enter code, examine it, move it, load and save it. You can also instruct it to search for a string and test a subroutine.

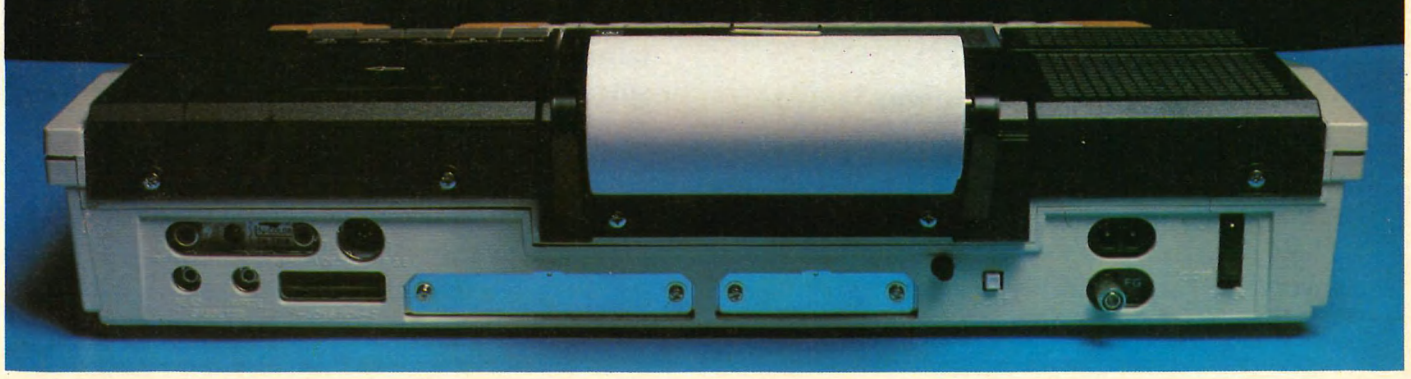
Minor but pleasing features like the machine-code monitor go a long way towards making up for the limitations of the MZ-700's design. But one might wonder why Sharp has done so little to develop a new system. The company's own answer is that it wanted to ensure that the MZ-700 was software-compatible with previous models.

A more general explanation might lie in the tendency of Japanese computer manufacturers to stick to conservative designs and to shy away from innovation.

Not everyone, however, wants the most advanced features in a micro. The MZ-700's appeal lies more in the fact that it offers an integrated system. It is highly convenient to have a built-in printer and cassette drive, and the console is a pleasure to use. As the home computer counterpart of a music centre the MZ-700 should find a ready market. ■

CONCLUSIONS

- The MZ-700 comes into its own as an integrated system. At around £400 for the full system with a four-colour printer/plotter and a cassette drive, a 64K micro with a well designed console must be considered good value.
- Graphics and sound on the £250 MZ-700 are crude in comparison with the facilities offered by other micros in this price range.
- The inconvenience of having to load Basic from tape outweighs the flexibility to load other languages.
- To some extend the inclusion of a printer/plotter with some extensive software to drive it makes up for the absence of a high-resolution screen.
- It may not appeal to games players but as a reliable and well-built machine would be suitable for more serious computing.



Three out of every four computers going into schools are BBC Micros. Is there a lesson to be learned by every user?

As part of the current government subsidised scheme aimed at introducing micros to schools, the Department of Industry undertook a survey of machines available and made recommendations to education authorities all over the country.

The BBC Micro met their priorities exactly: it is economical yet fast and powerful, and it can justify the investment involved, through its capability to grow with the needs of the user and with the rapid changes in technology.

Teachers and education authorities agreed, and today it represents over three-quarters of all micros being ordered for schools across the country under the DOI scheme.

The BBC's choice too.

In choosing a machine to put their name to for their massive Computer Literacy Project, the BBC had the same set of priorities as the DOI. The BBC Micro is now an integral part of that project, which includes books, software, courses and a number of major television series, one of which, "Making the Most of the Micro" is now being broadcast.

All this for only £399.

The BBC Micro is light and compact. It generates high resolution colour graphics, and is capable of synthesising music and speech using its own internal speaker. The keyboard uses a conventional layout and typewriter feel.

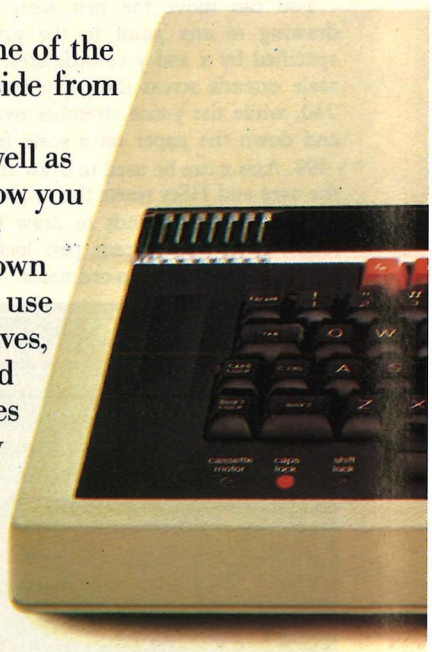
The most sophisticated version (called Model B) is available for only £399. (There is also a basic model available, the Model A, at £299.)

Designed to grow.

Last year the magazine "Which Micro?" said that the most attractive and exciting feature of the BBC Microcomputer was its 'enormous potential for expansion'.

This is indeed one of the features that sets it aside from the competition.

For example, as well as interface sockets to allow you to connect to a cassette recorder, and to your own television, you can also use video monitors, disc drives, printers (dot matrix and daisy wheel) and paddles for games or laboratory use.



You can also plug in ROM cartridges containing games with specialist application programs.

The Tube. A unique feature.

The Tube, which is unique to the BBC Micro, provides for the addition of a second processor via a high speed data channel. The possibilities are enormous. For example, the addition of a second

3MHz 6502 processor with 64K of RAM doubles processing speed. While a Z80 with 64K of RAM opens the door to a fully CP/M* compatible operating system, with all the benefits for business applications.

Linking up with other computers.

The BBC Micro also offers a facility of immense potential value to schools, colleges and businesses. It's called Econet® – a system which uses telephone cable to link with other BBC Micros. A number of machines can then share the use of expensive disc drive and printer facilities.

Make full use of Prestel & Teletext.

With special adaptors you will not only be able to turn your TV set into a Prestel terminal and Teletext receiver, but you can also take data and programs direct from these services. (The programs, which are known as telesoftware, are already being broadcast by BBC's Ceefax service.) This is another first for the BBC Micro.

BASIC plus.

A sophisticated version of BASIC has been chosen for the BBC Micro, which incorporates features normally found only in more advanced high level languages. However, there is also a facility allowing access through a simple command to another language – for example, PASCAL, FORTH and LISP.

*Trademark of Digital Research.

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Will Mattel's £90 colour Aquarius make a big splash? Don Wilson checks out the U.S. newcomer.

PLAYING GAMES is a serious business for toy-maker Mattel. The U.S. giant already has plenty of experience in the multi-million pound video-games field with its Intellivision system. Now the £90 Aquarius is Mattel's way of saying that it is ready to take on the home-computer market.

Mattel originally planned just to upgrade the Intellivision games machine to a home computer. In fact, I saw the prototype in the U.S. some four years ago. Even though Intellivision owners will soon have the keyboards that will turn their machines into micros, Mattel also decided to build a complete home computer, the Aquarius, as a totally separate project.

At £90 for the basic computer, the Z-80A based Aquarius is priced to compete with the ZX-81, Spectrum, Oric and Vic-20. It has a 40-column by 24-line display and graphics resolution is high at 320 by 192.

The pre-defined graphics in the Aquarius character set — see figure 1 — can be Poked to the screen or printed using the CHR$ command.

Text and graphics

Mattel's Aquarius runs a standard form of the widely-used Microsoft Basic — the same that is resident in the Dragon 32, for example. Unlike the Dragon, however, text and graphics can be easily mixed.

Although billed as a 4K micro, the Aquarius has only 1,700 bytes of memory to offer. The rest is used up by the video RAM.

Dutifully following the steps a first-time user would take, I started with a look at the manual which like the Aquarius itself is produced in Hong Kong. I was pleasantly surprised by this well-written book — in fact it is one of the best I have seen.

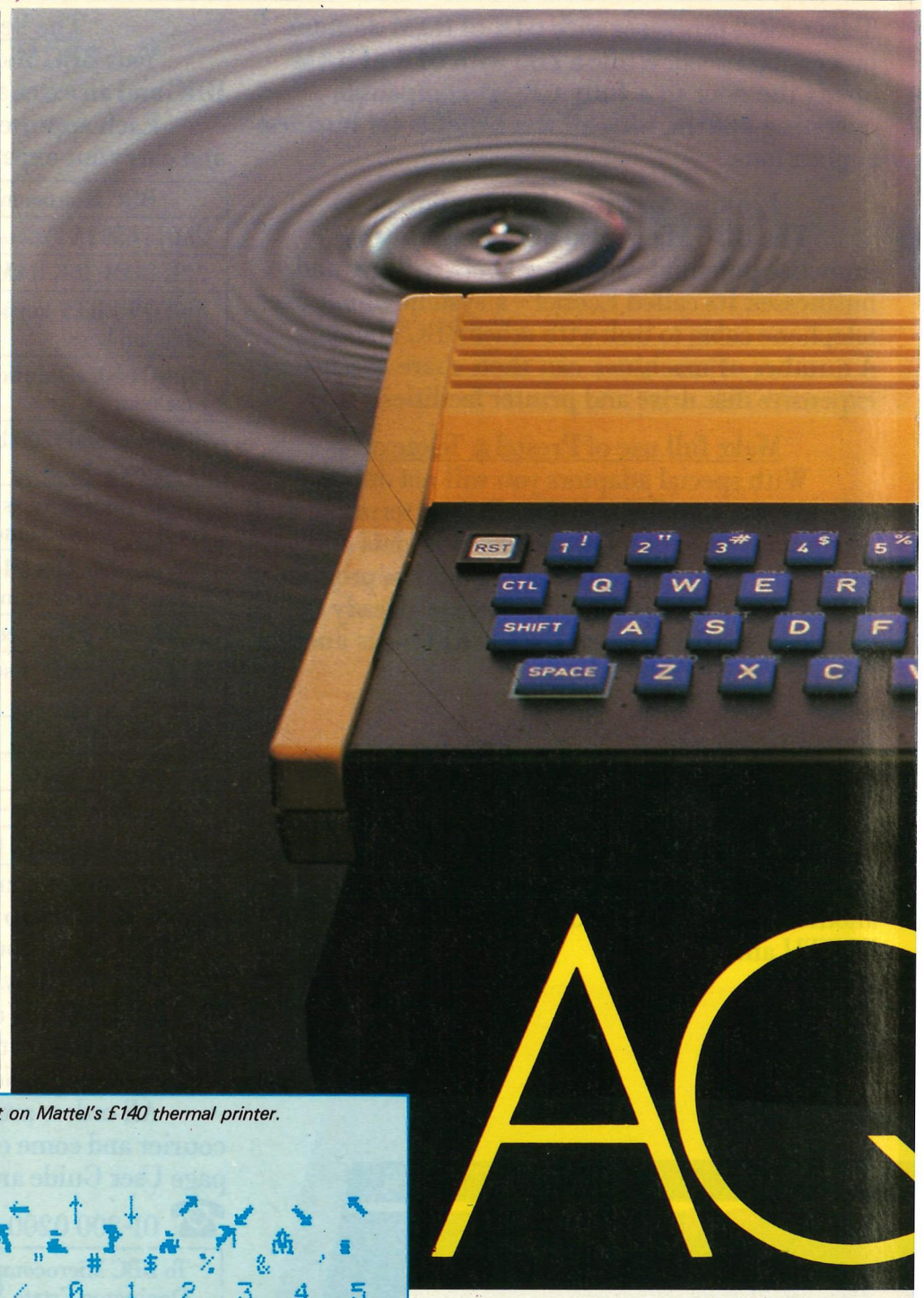
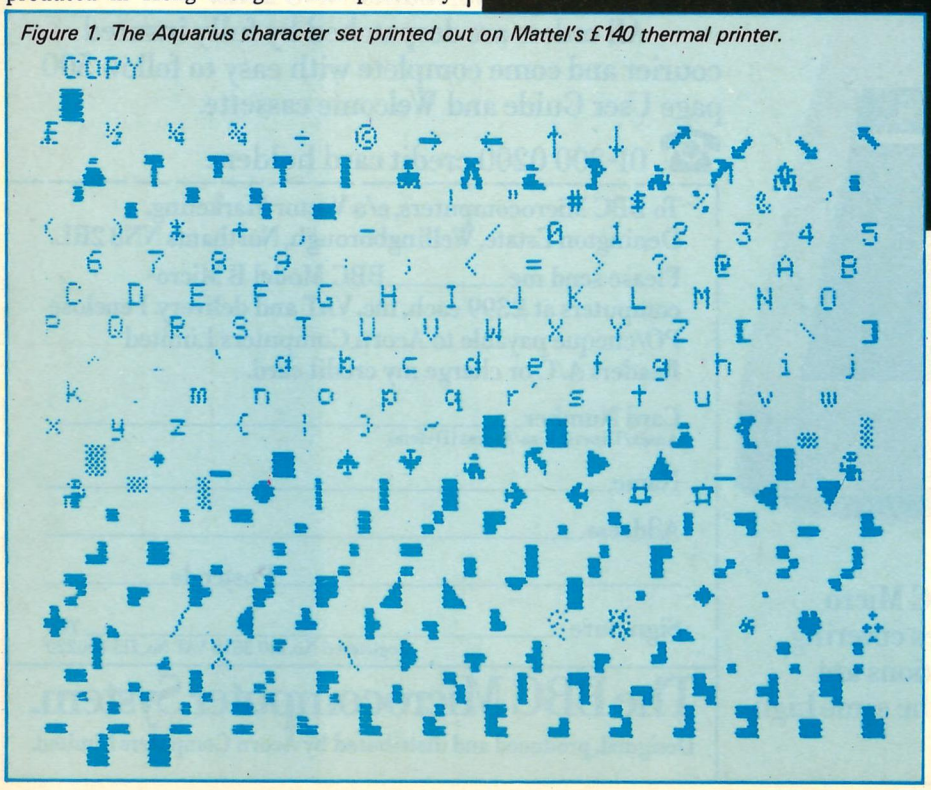


Figure 1. The Aquarius character set printed out on Mattel's £140 thermal printer.



It does not suffer from the awkward English that mars many manuals printed in the Far East, nor does it assume a knowledge of computers. It uses a step-by-step approach to most topics and there are no lengthy explanations of the inner workings of the machine. My only complaint is that it has no alphabetical index.

As well as the manual you are supplied with a ring-binder of quick-reference cards. They are designed to come to your rescue if you start to panic at the keyboard.

The micro's 49 moving keys are small and rubberised — similar to the Spectrum's but require a far firmer touch than those on Sinclair's machine. There is no full-size space-bar.

I found that it was very easy to mis-type —

you think that you have pressed a key only to find several characters further on that a letter is missing. The Aquarius also lacks an auto-repeat facility. If you hold down a key on Mattel's machine the character will not carry on being repeated until you lift your finger again.

Multi-function keys

Like the Spectrum, the Aquarius has multi-function keys. A keyboard overlay shows you which keys give the facility to print such commands as Run, List, Goto, CLoad. I find multi-function keys particularly useful because they make for faster programming. On the Aquarius, as on any other machine that uses this feature, it took a little time to get used to the location of the particular keywords.

Minor features that the Spectrum cannot boast are the Aquarius on/off switch and power-on light. It also has a reset button, so it is not even necessary to turn off the power while the machine is in use. I like the position of the reset button at the top left-hand side of the keyboard. As an added safety measure the button is protected by a wall to avoid accidental erasure of programs. Even if you do inadvertently trigger the reset, you can still rescue a program in the machine simply by pressing Ctrl C which returns a Break message.

When you first switch on, text appears in black on a light-blue screen. At first I had problems getting all 16 colour variations. However when I moved to another television set I found that the Aquarius really does produce all the shades it promises, but with a tendency towards the blue/green end of the spectrum. The eight extra colours which the Aquarius offers and which the Spectrum does not are just light and dark shades of the basics, but their existence gives more variety to any program that uses graphics.

The basic machine has only one sound channel. Although the manual claims you can use the Aquarius "to create an astonishing range of sound by specifying duration and tone with the Sound statement" it does not elaborate on how this may be done apart from the unhelpful advice "in general the higher the tone number the lower the tone". With the Mini Expander two extra sound channels become available, which puts the Aquarius on a par with the Vic-20.

I carried on through the handbook, typing out a number of the simple programs provided. It was at this stage I met a problem. The Aquarius does not come supplied with a cassette lead. There is a normal five-pin DIN

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socket at the back of the machine. You are told to plug into the Mic/Ear socket of your tape recorder and ignore the remote since the machine does not recognise it. I am told that the Tandy lead supplied for the TRS-80 is compatible. A cable is supplied with the £50 Data Recorder which can be bought as an optional extra.

At the top right of the console is a removable cover which conceals the expansion port. Most of the cartridges sold with the Aquarius can be plugged straight into the cartridge port without any additional memory. There is even a self-contained word processor — although, 1,731 bytes of memory will not allow you to write much more than the opening paragraph of your long-planned autobiography.

Into this expansion port is plugged the Mini Expander Module. Priced at around £50, this add-on is essential if you wish to have extra memory or use the game paddles. Although most of the games can be played from the computer keyboard, most enthusiasts will want to use paddles for greater flexibility.

If, like me, you like to have your computer on a table with a television set behind it, plugging in the Mini Expander changes the shape of the Aquarius from a neat oblong into a bulky L shape.

The program and memory cartridges slot into two ports at the top of the expander. Initially I found them difficult to fit — they require a firm push to ensure a perfect connection. Two modules are available for increasing the memory — 4K, which gives a total of 5,827 usable bytes, and 16K which means 18,115. Mattel claims the Aquarius will be capable of expansion to 52K, and so I must assume that other memory modules will become available.

A 40-column thermal printer is an optional extra. Priced at £140 it compares unfavourably with the ZX Printer at £40. It uses an RS-232 interface and produces a good, clear hard copy of program listings. It can also reproduce graphics. Like any printer that uses 4in. wide paper it is little use for anything else, such as producing lengthy documents. The more adventurous user will find that he will soon have to upgrade to a larger printer. It is here that I must start to seriously question the market at which the Aquarius is aimed.

At first sight, the Aquarius' £90 price tag is attractive and may lure the unwary into buying a machine that very soon becomes expensive. Thinking that it will make a good first machine at less than £100 buyers could soon find that to run their own programs they need the Mini Expander Module to overcome the limitations of the Aquarius. This puts the price of the machine at around £140 — expensive for a games machine, and still no extra memory.

The 4K RAM pack bumps up the price another £20 and the 16K cartridge another £50. So in order to reach 18K of RAM the machine is already priced around £200 — and even then cannot offer a real keyboard.

Mattel promises a large selection of games cartridges which will be priced at between £15 and £20. But the two applications programs that I saw — the word processor and Finplan, which bore a resemblance to Vu-Calc on the Spectrum — are to be retailed at around £50. Since Spectrum's Vu-Calc is available on cassette for £8.95 the Aquarius version is pricey.

Although there are very few cartridges available now the catalogue promises a reasonably wide selection and Mattel says that it will have "a considerable number" ready for the seasonal market — which presumably means the Christmas period.

Other software houses have already indicated that they will be producing cassette-based programs for the machine straight after launch. This will at least bring down the price of software.

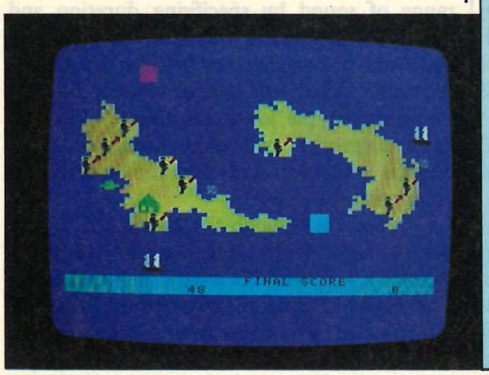
On the hardware side Mattel is selling a Data Recorder for £50. This is not essential for the Aquarius — any reasonable quality recorder will do so long as it has mic and ear connections. My only reason for buying one would be aesthetics — it matches the colour scheme.

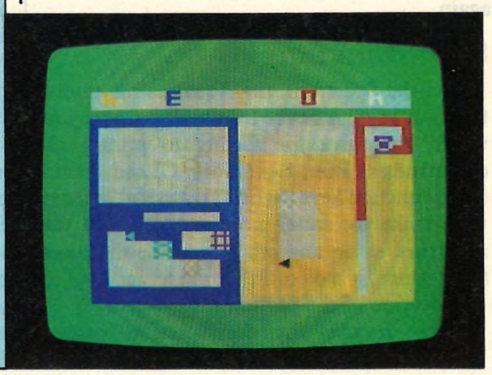
A Modem is also promised for later this year. But with the machine's limited RAM, many networking facilities will be beyond it without the extra expense of more memory. Mattel will also be producing a Master Expansion Module to operate a dual disc drive which is claimed will bring the CP/M operating system to the computer.

Mattel expects to sell more than 100,000 Aquarius micros and has already signed retailing deals with major High Street stores such as Smiths and Boots. I cannot help feeling that the limitations of the machine and the level of its price may mean that this is not the dawning of the age of Aquarius. ■

CONCLUSIONS

- The Aquarius is well made, attractively designed and should withstand heavy wear.
- Its 16 colours and 320-by-192 graphics resolution make it a good games machine.
- For the first-time buyer its handbook is informative and will go some way to dispelling the mysteries of computing.
- Its price when the add-ons are included makes it costly and the limitations of the keyboard and memory make it unattractive for any serious applications.
- You should compare it with the Spectrum, the Vic-20 and the Oric, before you decide whether or not it offers value for money.





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ZX SPECTRUM SOFTWARE

From deep-space adventure to worldly board-games in Meirion Jones' survey.

LESS THAN A year ago the appearance of Scrabble on disc for the Apple caused consternation among micro owners. The program defeated three-quarters of the humans who challenged it to a dual of words. At least Scrabblers could comfort themselves with the knowledge that they had been beaten by a £750 disc-based system. Now Psion has taken even that consolation away by launching an improved version of the game with a bigger dictionary and better graphics which will run on a £150 system — the 48K Spectrum and a cassette recorder.

This illustrates the rate at which Spectrum software is improving. The latest releases include clever implementations of board-games like monopoly and arcade favourites such as Scramble, long and complicated Adventures with names like Knight's Quest and combinations of arcade and Adventure like Pixel's Trader. While serious and educational material software is still thin on the ground, programs like Hewson's Countries of the World show how much useful information can be packed into the Spectrum.

More originality

Unfortunately the standard is not uniformly high. Sometimes imagination is lacking. Bridge software still insists on marketing what it calls "an exciting game for two to six players". Yes, you guessed, it is boring old Hangman.

At other times graphics are weak. Micromega sells a version of Roulette which features a roulette wheel which looks more like a flying saucer on an off day. There is still too high a percentage of unloadable tapes and of tapes which you wished had been unloadable. Davic Games Tape 1, for instance, features a game which has Tooth Monsters instead of ghosts, which is probably the dullest-ever version of Pac-Man. The Tooth Monsters themselves are about as threatening as a pair of jelly babies.

If you want real tooth monsters try Imagine's excellent Molar Maul. This is a real nerve-tingler from the moment that an enormous set of gleaming teeth appears on the screen like something out of *Jaws*. Armed only with a toothbrush and toothpaste you have to defend these dentures from swarms of evil bacteria.

These germs go by the name of Dentorium Kamikazium which allows Imagine to talk about "the DK Menace" — a triple pun partly at the expense of Imagine's Ipswich-based rivals DK'tronics.

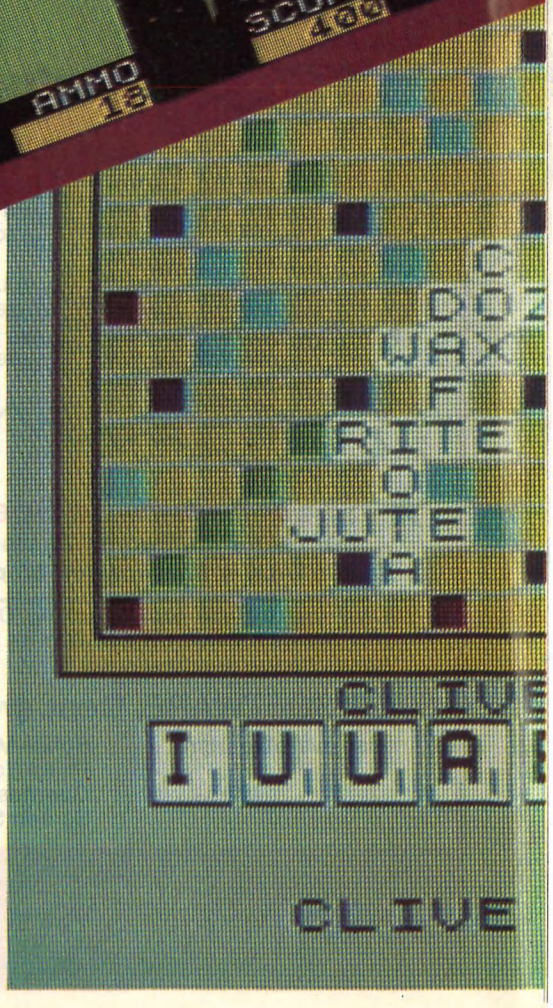
Two down and one to go before the next wave of DK'tronics Tanx hits you. Meanwhile Psion's Scrabble, main picture, can throw 12,000 words at you.

Imagine's punsters are at work again on the cover of Arcadia where we are told we are fighting against the "deadly menace of the Atarian empire". Perhaps this explains why Sinclair owners have shown such enthusiasm for Arcadia because the game itself is just a lacklustre version of Galaxians. Much better is Imagine's Schizoids.

If, like me, you have always wanted to be a bulldozer, Schizoids is the game for you. You are a bulldozer in outer space and your job is to push tumbling cubes and pyramids into a nearby black hole without falling in yourself. Perhaps this nearby anomaly in the space-time continuum affects the wavelength of light. At any rate the game itself is only in black and white.

Pixel is another company which cannot resist veiled messages. Trader is part space Adventure and part arcade game. The Adventure, trading commodities between different worlds, is more convincing than the crude skill tests such as finding the right orbit when approaching a planet.

Trader may well be bought as much for its



attractive packaging — which includes a survival guide for the would-be Trader — as for the game itself. After buying supplies for your first trip you set out for the planet Psi where the inhabitants — yes, Psions — who look like a cross between Clive Sinclair's beard and a muppet ask you tiresome questions such as "What is the formula for carbon monoxide?" or "What is your first name?". Entering "Clive" as an answer elicits the response "What a strange name". So, for that matter, does any other reply.

If disaster should strike, a caption will appear saying "Is this the end . . . ?" The answer is "No" because Trader is a trilogy so there are another two complete parts to load from the tape. There are many more traditional text Adventures of the "Go south, open door, take gold" variety but the narrowness of the replies they will accept is often irritating.

Down the mines

Mikrogen's Mines of Saturn starts with a cheery "Have fun" and then proceeds to ask questions like "Tunnels lead N, S, E and W — what will you do?" Attempts to answer "N" or "go N" or even "go n" will not wash. It must be "go North" or nothing. At least Phipps' Knight's Quest has a 120-word vocabulary to help you on your damsel-ridden way to a castle in the air.

Everest by Richard Shepherd Software is more of a strategy game than a straight Adventure. You have to take enough food and rope to climb the mountain and cope with every hazard. I enjoyed the climb but I never reached the summit — partly because the Sherpas are not what they used to be.

When Sir Edmund Hillary climbed Everest for the first time he managed to find a Sherpa called Tensing. The time when you visit a Nepalese hill village to recruit porters you are asked to choose between Sherpas with names like Keith, Brian, Ron, Tim and Paul. Presumably they are ex-hippies, lost on the road to Katmandu.

Things obviously still are what they used to be down at Mikrogen. If Andy Capp sends you into fits of laughter Mad Martha might just raise a smile. It is the same old story, boy meets girl, well, hen-pecked husband meets axe-happy wife — all very predictable. Mikrogen also sells arcade games like Cosmic Raiders — a competent impersonation of Defender with a long-range screen and grabbers.

Build rockets in Jet Pac, left, and arm yourself to the teeth in Molar Maul, above.

Melbourne House's variation on the same theme is called Penetrator. The display looks more like the arcade version of Scramble. A training facility to help you build up specific game skills is a good idea. C-Tech's Rocket Raider is yet another competent variant on similar lines.

Artic offers a suicidally fast asteroids game called Cosmic Debris. Still in the arcades, both Elfin Software and Quicksilva produce robot battles which are of the Pac-Man-meets-Tanks variety.

Elfin's Tobor has the more exciting opening titles but loses on points to Quicksilva's QS Frenzy whose exotic science-fiction plot seems to offer a better justification for the game.

Speaking of Tanks, DK'tronics 3D Tanx was one of my favourite programs in the whole batch. You can track you gun barrel from side to side and adjust the elevation as you lob your shells at four lines of moving tanks which can fire back at you. Although the opposing tanks at first appear to be crawling across a structure that looks more like Brighton's West Pier than a battleground, this is one of my four games you might catch me paying to play in an arcade.

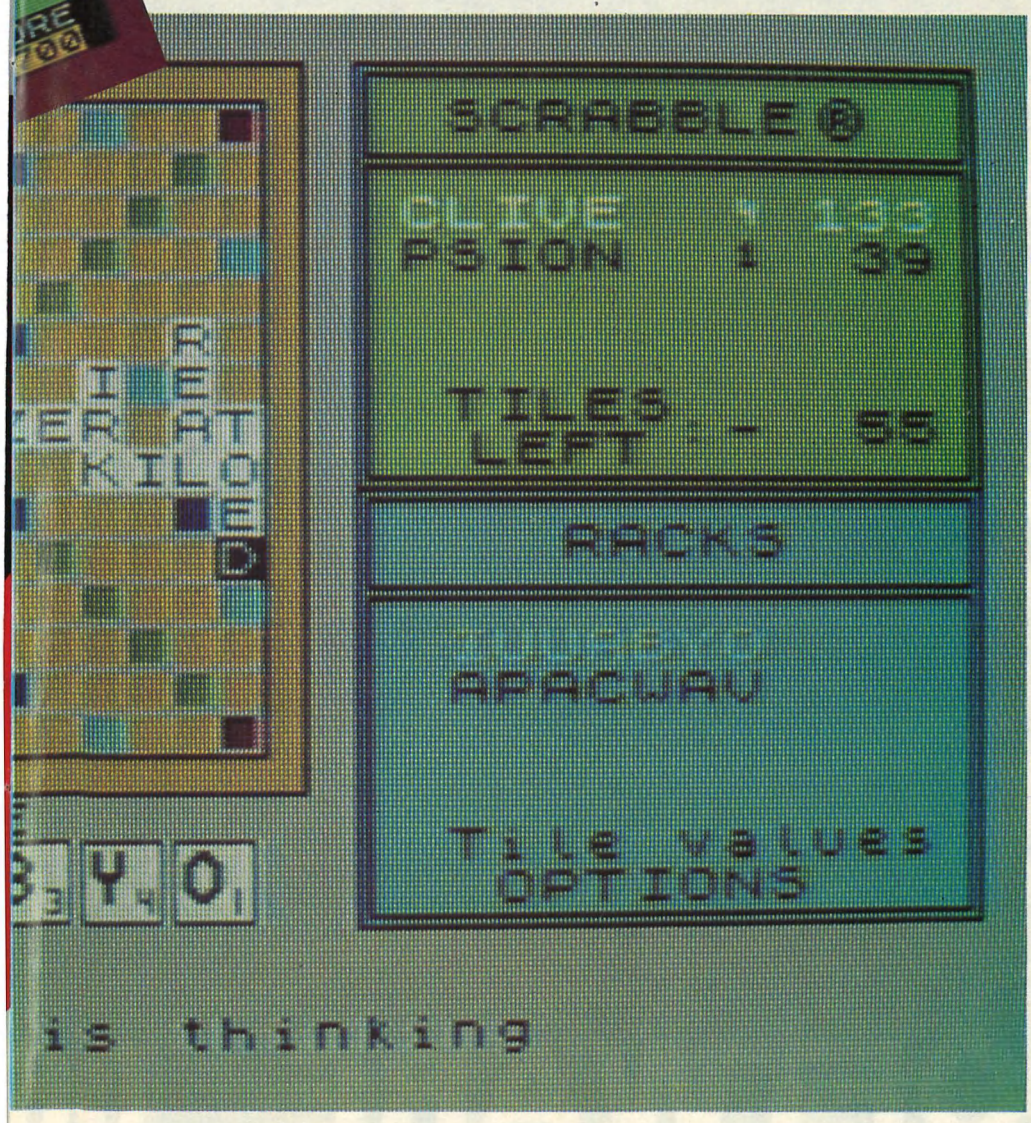
Join the professionals

Artic's Combat Zone is another ambitious attempt at a Tank game. Your target and the landscape — a few pyramids on an invisible plane — look like refugees from Psion's Vu-3D program. They are very simple three-dimensional shapes but they change position smoothly and realistically as if you were walking past them in some world inside your Spectrum.

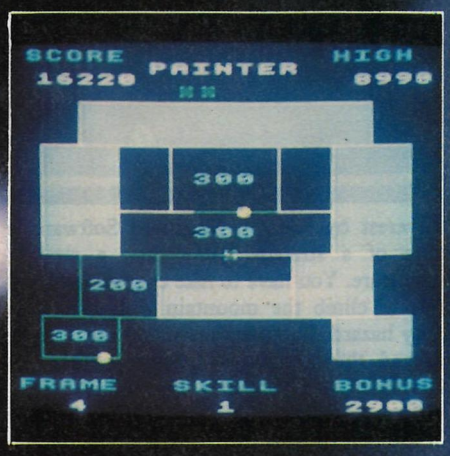
You and your opponents fire fragments of cubist paintings at each other but the abstraction is not so important as the fact that you are playing the first real Spectrum game in three dimensions — Vu-3D itself is a Psion program which allows you to build up three dimensional objects on the screen and then rotate them, or float them towards you and back again. In effect it is a crude version of the mainframe programs which create the effects for films like *Tron*.

ET makes an appearance too in an Abbex Adventure with voices called ETX.

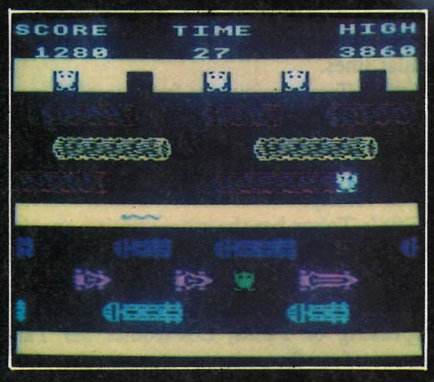
(continued on page 66)



32K BBC ALL O.S.'s

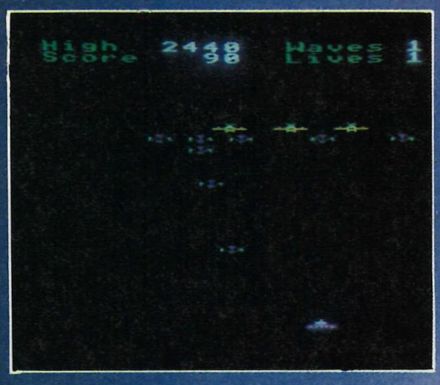


PAINTER Written entirely in machine code this fast arcade style game features sixteen different screen presentations and six skill levels which make the game harder as you get better. **£8.00**



PLANES Another A&F machine code special. Select either 'fast' or 'slow' and stand by your keyboard for action. Hi-score tables and brilliant graphics **£8.00**

FROGGER Also written in machine code this is a frustrating exercise in crossing the road, fording a river and trying for extra points by picking up the lady frog. Brware of the snake and don't forget the crocodile! **£8.00**



TOWER OF ALOS An excellent adventure game which has the feature of saving your character if you want to. Also for the Model A. **£6.90**

PHARAOH'S TOMB The interactive adventure game for the BEEB. Pick up the gold pieces, fight the spider and be scared penniless by the mummy. Work out the magic words and you are on your way. **£8.00**

LUNAR LANDER One of our old favourites and still just as difficult to get down in one piece. **£6.90**

ATOM

SPACE PANIC & PAINTER The best excuse for keeping your ATOM. Space Panic got a 99% review in PCT (Dec. 82) an d will keep you at the keyboard for hours.

Painter — the original program — was the arcade version based on this? It got a 90% review in PCT (Jan. 83)

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A+F SOFTWARE 06

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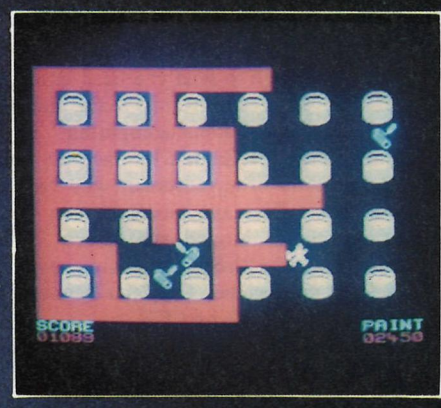

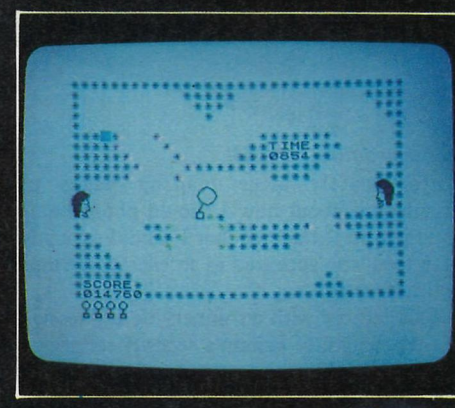

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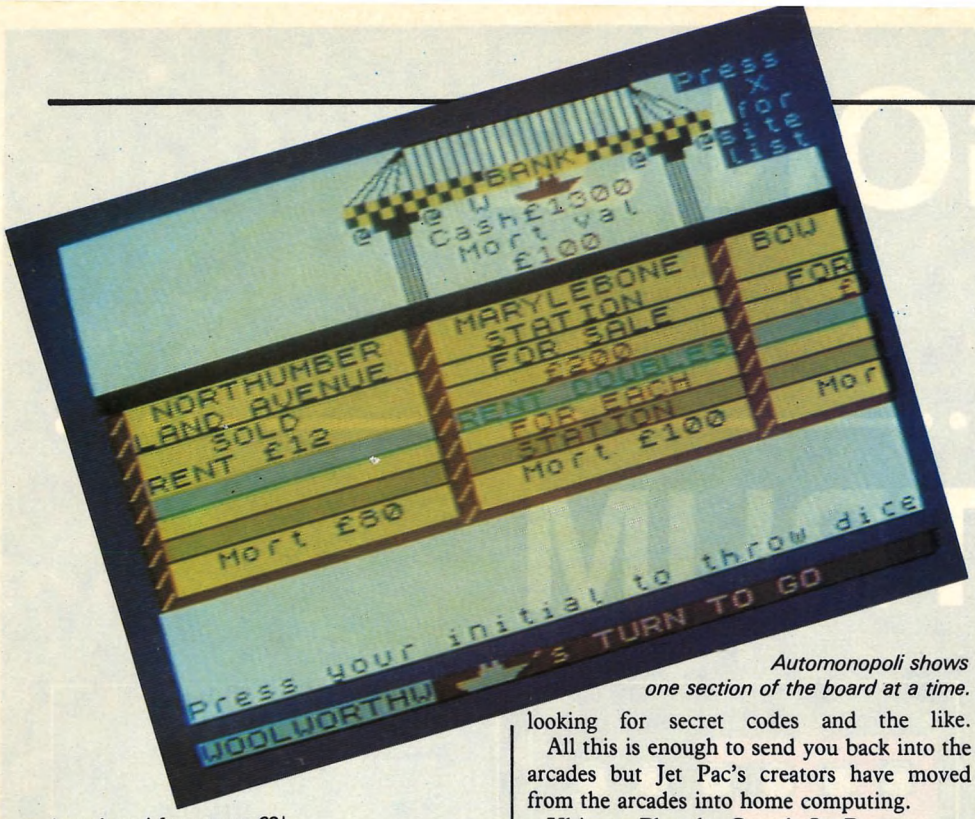

Automonopoli shows one section of the board at a time.

(continued from page 63)

Unfortunately after loading pages of instructions about how I should phone home ending with the advice that I should treat any MI5 man who appeared as an enemy, the tape self-destructed.

This left me with an unnerving impression of the strength of Britain's security services.

The secret police are certainly important in DK'tronics strategy game called Dictator. The setting is a banana republic. The instructions ominously point out that "your rule is measured in months". You have to balance political factions, army, secret police, peasants, landowners, guerillas and superpowers if you are to survive.

Breaking into embassies would doubtless be all in a day's work for a dictator. So for all prospective saviours of the nation, Sinclair's Embassy Assault will come in useful. It is very much like those maze games which present your view standing in the maze. Instead of trying to avoid a minotaur, this time you are looking for secret codes and the like.

All this is enough to send you back into the arcades but Jet Pac's creators have moved from the arcades into home computing.

Ultimate Play the Game's Jet Pac puts you into the position of an astronaut who has to build a rocket from the pieces he can find sitting on clouds around the screen. The scenario is not entirely convincing but it makes for a good game. The same cannot be said of the simulations by CCS.

CCS's representations of the oil business, Dallas, running a printers, Print Room, and of international aviation, Airline, may be realistic but they are not very exciting. Although these were originally designed as training for middle management, livelier presentation would not necessarily have made them less useful. Hewson's simulations of air-traffic control, Heathrow, and the Nightflite flight simulator are more convincing.

Board-games seem to transfer particularly well to the Spectrum. Psion's Scrabble has already been recommended. With its four levels of play and 11,000-word dictionary it can offer almost as tough opposition as you could want. There are also two different approaches to that old favourite Monopoly.

Automonopoli offers a continuous display of the part of the board around your current position. This display moves smoothly when the dice are thrown. Do Not Pass Go from Workforce has a less interesting display but at least shows the whole board all the time. Automonopoli allows you to personalise the program with the names of players and both programs give the option of being either a board for humans to play on or of letting the computer join in as a player. In each case the computer becomes a soft opponent once you have reached the stage of building houses and hotels.

If you have ever wandered into a rundown dockland hotel or pub and been confronted by the sort of balding drunk who says he used to sail the seven seas and boasts that he can name the capital of any country you care to choose, I can reveal his secret. At home he has a Spectrum with Hewson's Countries of the World up and running on it.

At the touch of a button it will remind you that N'djamena is the capital of Chad or that Yaounde is the capital of Cameroon. In the corner of the pub someone with probably be playing a video game not unlike Firebirds.

Softek's Firebirds is a Galaxians-type game distinguished by good croaking noises from the birds. Still on the subject of sound effects Workforce's Jaws Revenge is very noisy and fun. The graphics are great. You are a shark and you are after the divers and boats which are after you.

Mined Out from Quicksilva is a very strange version of Mines. It is subtitled "Rescue Bill the worm from certain old age" and if you find a way through the first minefield you then have to rescue damsels in distress. Someone at Quicksilva has been playing too many Adventure games and it is beginning to show.

The last words on the cassette packet read "the image fades to soft focus which is replaced by waves falling on a rocky shore, except in Bill's dream there are no waves or soft focus . . ." It is certainly time that software cassettes carried a government health warning. ■

Company	Game	Memory	Price
Abbex	ETX	16/48K	£5.95
Artic	3D Combat Zone	48K	£5.95
	Cosmic Debris	48K	£4.95
Automata	Automonopoli	16/48K	£6
Bridge	Lynchmob	16K	£6.50
CCS Software	Dallas	48K	£6
C-Tech	Rocket Raider	16K	£6.50
DK'tronics	3D Tanx	16/48K	£4.95
	Dictator	48K	£4.95
Elfin	Tobor	48K	£7.95
Hewson	Heathrow	16/48K	£7.95
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Imagine	Molar Maul	16/48K	£5.50
	Arcadia	16/48K	£5.50
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Micromega	Roulette	16/48K	£4.95
Mikrogen	Cosmic Raiders	16/48K	£5.95
	Mines of Saturn	48K	£5.95
	Mad Martha	48K	£6.95
Phipps	Knight's Quest	48K	£5.95
Psion	Scrabble	48K	£15.95
	Vu-3D	48K	£9.95
Quicksilva	Frenzy	16/48K	£4.95
	Trader	16/48K	£9.95
	Mined Out	48K	£4.95
Richard Shepherd	Everest Ascent	48K	£6.50
Sinclair Research	Embassy Assault	16/48K	£4.95
Softek	Firebirds	16K	£5.95
Ultimate Play The Game	Jet Pac	16/48K	£5.50
Workforce	Do Not Pass Go	48K	£6.95
	Jaws Revenge	16/48K	£5.95

Company	Address
Abbex	20 Ashley Court, Great Northway, Hendon, London NW4.
Artic	396 James Reckitt Avenue, Hull, North Humberside.
Automata	65a Osborne Road, Portsmouth, Hampshire PO5 3CR.
Bridge Software	Dept YC 36 Fernwood, Marple Bridge, Stockport, Cheshire.
CCS Software	Dept YC, 14 Langton Way, London, SE3 7TL.
C-Tech	184 Market Street, Hyde, Cheshire.
DK'tronics	Unit 2, Shire Hill Industrial Estate, Saffron Waldon, Essex.
Elfin Software	Hudsons House, Battery Road, Great Yarmouth.
Hewson Consultants	60a St Mary's Street, Wallingford, Oxfordshire.
Imagine Software	Masons Buildings, Exchange Street East, Liverpool.
Melbourne House	131 Trafalgar Road, Greenwich, London SE10.
Micromega	230-236 Lavender Hill, London SW11.
Mikrogen	24 Agar Crescent, Bracknell, Berkshire.
Phipps Associates	99 East Street, Epsom, Surrey.
Psion	2 Huntsworth Mews, Regents Park, London.
Quicksilva	13 Palmerston Road, Southampton.
Richard Shepherd	22 Green Leys, Maidenhead, Berkshire.
Sinclair Research	Freepost, Camberley, Surrey GU15 3BR.
Softek	329 Croxted Road, London SE24.
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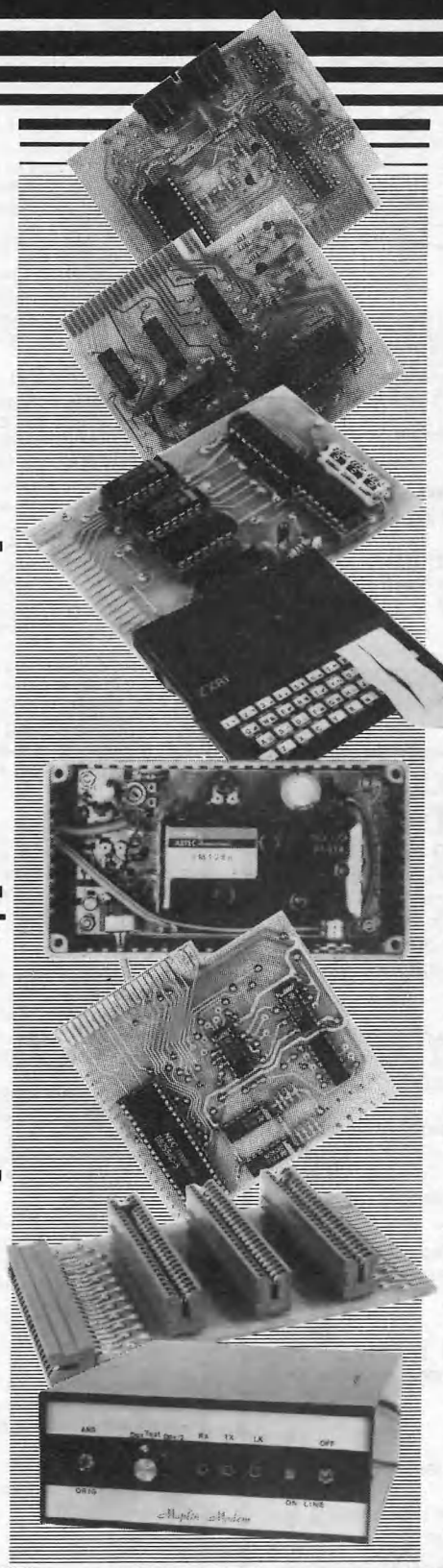

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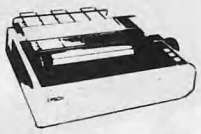

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WORD PROC

You have the technology, now all you need is the software. Bill Bennett assesses word processing for the home.

WORD PROCESSING was invented in 1968 by IBM. A magnetic tape machine connected to an electric typewriter allowed a typist to produce a number of copies of any letter or document typed into the system.

What made the word processor more than a clever but expensive photocopier was a simple editing facility which let the typist change small parts of the document on the magnetic tape. Today's word processors, range from home letter-writing packages, to huge devices the size of freezers capable of storing an entire encyclopaedia in memory.

The print you see on the pages of newspapers, books and magazines like *Your Computer* is produced by an advanced form of word processing called typesetting. Words are typed into a typesetting machine and juggled around. Modern photo-typesetting machines are only slightly more sophisticated than ordinary word-processors.

All these systems, from the most powerful dedicated microcomputers based around one special program to the most humble home unit all have a number of features in common. These are an inputting device — usually a keyboard — a real-time output device — usually a video display screen — a printer or batch output device, a working memory, a disc drive or tape back-up memory and a central processing unit.

Replacing the typewriter

More important than all that hardware is the software. Over half of the world's business computers are used at some time or other as word processors, which makes it the single most important computer application.

In the home a computer can be used in conjunction with a relevant software package to replace a typewriter.

Students can use them to type essays neatly and edit and correct them as many times as necessary. Some word processors interface with databases, allowing — for example — an almost identical letter to be sent to a list of people. The program might even print out a list of names and addresses at the end of the run to help you label the envelopes. Certain relevant phrases or words, such as Sir, Madam, Mr or Ms can be inserted at relevant points in the letter.

Word processors are popular with authors, who like to revise their material constantly before sending it to a publisher. The same applies to playwrights, scriptwriters and some types of journalists. Secretaries use word processors, and to some extent are being replaced by them. Because secretaries often have to type the same sentence time after time, they can, for example, type the sentence or paragraph just once, store it on disc and recall it with a few keystrokes each time it is to be used.

Certain professionals, especially solicitors, often need to write letters and documents which are cobbled together from standard clauses. They find word processors a boon. How about your local computer users' club? A word processor could help you produce a newsletter.

ZX SPECTRUM

The biggest-selling micro in Britain is the Sinclair Spectrum. As a word processor it has a number of limitations, but if you already own a Spectrum, a tape recorder and a printer, then paying a few pounds for a word-processing package is not going to break the bank.

The video output of the Spectrum, especially when white on black is more than adequate. It allows only 32 characters across, which is about the minimum useful width of a word-processor screen. The big let-down of the Spectrum is its keyboard, which simply is not suitable for touch-typing. The problem is not just the feel of the keys but also the lack of a space-bar. You could buy a separate moving-key board but this adds to the expense.

Like most home computers the Spectrum has an adequate tape-operating system which can be used to store prepared documents. It has the advantage of being reliable and faster than the tape-operating systems on most other home computers. Microdrives will give the Spectrum access to fast, reliable and relatively large files.

Unfortunately the Spectrum needs a special interface to be able to use a proper printer. The ZX Printer is not suitable for word processing. The ZX LPrint from Euroelectronics interfaces the Spectrum to any Centronics-type printer for about £35. There is also a £45 unit available from Kempston Electronics.

The Quicksilva word-processing package for the Spectrum is written in Basic. The advantage of this is that it allows the user to customise the program fairly easily. Such customisation will really come into its own when Microdrives become available. Unfortunately it also means that the response is slower than that of the keyboard.

Tasword is written in machine-code and is consequently faster. The author of the package has so much faith in his software that he used the package, together with the ZX printer to produce the useful manual. It is an impressive word-processing package when you take into account its low price and the limitations of the machine.

The Microl word-processing package is better organised and consequently more expensive than the other two Spectrum packages. At times it almost seems pompous. Unlike the other two packages it allows graphics characters to be used freely.

CESSING SURVEY

The home computer that seems to have been neglected by software houses is the Dragon 32. Its 6809 processor seems to have been too much of a challenge for programmers. Probably the best piece of Dragon software is a word processor called Telewriter. Telewriter was originally written in the U.S.A. for the Tandy Colour Computer, which is very similar to the Dragon.

As a word processing micro the Dragon is a little disappointing. Its so-called real keyboard does not appear to be up to taking the kind of beating that a hard-working word processor can expect. When using it I found that the machine's case tended to wander about all over the table. This is because it is so light. After weighing it down with books I found that it worked satisfactorily, but the keyboard just did not feel quite right.

Telewriter is a marvellous piece of software, and well documented too. It is excellent. Like all the other packages I looked at, the quality of the software was higher than that of the hardware. The Dragon has an awkward screen and is downright difficult to use with a tape recorder.

I particularly like the Demonstration program — always a good idea — supplied with Telewriter. Also praiseworthy is the way a number of different formats are available, matching the package to different printers. There is even a program to convert files from ASCII to the Telewriter format.

DRAGON 32

The keyboard is the front-end of any computer system and, when applied to a word processor system, its design is all important. Ideally a keyboard should be as near to a typewriter keyboard as possible. The keys should have a positive feel to them, so that you know when they are hit. If this is not possible then audio feedback in the form of a keyboard bleep can be almost as good.

Keys should be laid out as on a typewriter, in the QWERTY pattern. The more standard the better. The space between keys is important, fiddly little keyboards are much harder to use than those with the keys spaced in the conventional way. A proper space-bar is a great help, as are proper shift keys, ideally one at each end of the bottom row of letters.

The return key should be to the right of the middle two rows of letters, and it should be impossible to hit it by mistake, or to accidently hit some other key which has dire consequences. Function keys are a great help to word processing, as they enable the various functions of the software to be implemented quickly. There is also less chance of something going wrong if they are used.

Function keys

Dedicated word-processors usually have the function keys marked with the relevant function. Home packages are easier to use if there is some way of doing this. For example, there is a strip of Perspex above the function keys on the BBC Micro, which can have a printed list of the functions inserted beneath.

Some people find it easier to type using a small keyboard which will sit on their lap. Many home micros are ideal for this. On bigger micros, there is often a numeric keypad to the right of the main set of keys. This can be used in a word processing system as a cursor control pad. Other ways of moving a cursor around involve control-characters, function keys and in some cases even joysticks.

Repeat keys can be useful and many home computers have an auto-repeat facility which starts after the key has been depressed for a certain amount of time. There are a number of alternatives to the keyboard approach but the only one that is likely to be seen by most home users is the Microwriter, which can be used with the fingers of one hand.

The display is every bit as important as the keyboard. Together with the keyboard it forms the interface between the user and the word processor. Before the advent of cheap personal computing the keyboard-display team was often known as a terminal, a name which is a hangover from the days when computers were large expensive machines with a number of terminals.

For serious word processing, choice of display is crucial. A bad display can ruin your eyesight if used for more than a few hours a day.

For display the home user has three choices: you could spend money on a monitor, simply

(continued on page 73)

Word-processing packages — listed by machine.

Name	Company	Price
ZX-81		
Tasword	Tasman Software	£6.50
Spectrum		
Tasword	Tasman Software	£7.95
Eddie	Quicksilva	£5.95
The Word Processor	Microl	£9.95
Dragon-32		
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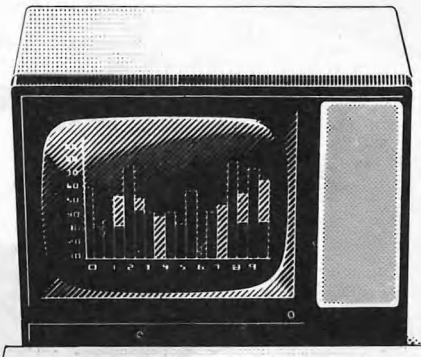

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VIC-20

The Commodore Vic-20 has the best keyboard in its price range. It is solid and robust, there are four function keys, and it is the right size, shape and weight. I could type on it all day. Despite this the Vic is not exactly an ideal micro to use as a word processor.

For a kick-off, the screen width is a mere 23 characters. That is about four words. After a while you begin to get hopelessly lost, because you cannot realistically read through a document when only 22 lines of 23 characters each are visible. The other big black mark against the Vic is its tiny memory — less than 3K is available to play with.

Wordcraft-20 gets around the memory problems by supplying some of its own. This is done easily because the package comes in a plug-in cartridge that has both ROM and RAM. Even with the exta 8K supplied, there is only room for around a thousand words, which is not a very long document. If Tolstoy had had a Vic-20, then *War and Peace* might only have been a pamphlet.

The Wordcraft-20 package has the advantage of being switchable. This means that you can return to Basic, and use the 8K of RAM for other purposes. It does of course work with the disc unit. It is an ideal unit for someone who already has a Vic-20.

(continued from page 71)

use the television set, or if your machine allows it, an LCD display. For home word processing there is little point in spending a lot of money on a monitor unless you intend to do a lot of word processing, or you have another use for the monitor.

A monochrome monitor has the advantage of higher resolution than the average TV, but it costs money. Also most home micros do not readily connect to monochrome monitors. Often they have green screens with light-green characters, which in theory at least are better for the eyes than white on black. Many experts prefer yellow on a brown or orange background, as this is thought to be more restful.

Most home users will be content with the more usual TV display. If you intend to use this it is more important than usual to tune the set in properly. You may even need to adjust the setting on your micro. Do not attempt this without consulting your manual because you could make things worse than they already are.

The set needs to be properly tuned because you are going to spend a lot of time looking at the screen, and especially if your micro is capable of 80 characters to a line, you will quickly get eyestrain. Some word processors make use of colour, but the majority do not. It is up to you how you adjust for this. I find that a sharper clearer picture can be obtained on most machines by sacrificing some of the colour quality.

Certain home micros have a naturally white or green background with the writing in black. This is harder to tune properly than a predominantly black background with white, or light-coloured characters. If your software allows you to choose, always choose a darker background. A television is capable of displaying fewer characters on the screen than a monitor, but with home computers the width of the display is usually determined by the hardware. A screen which can display more characters makes it easier to find your way around the text you are processing. It can also allow you to inspect on the screen the actual format your document will take when it is finally printed out.

If the screen width is as narrow as the Vic-20 — only 22 characters wide — horizontal scrolling may be used to allow you to input long lines. Alternatively the software might just turn the text around at the end of a line and leave the width-handling until the output stage.

The majority of home micros can interface to Centronics-type printers fairly easily. That does not mean that the printer has to be a Centronics one, merely that it has that type of interface. This opens up a whole range of printers to the microcomputer, from the Sharp/Tandy multicolour plotter/printer upwards.

The Tandy CGP-115 produces adequate printout in colour for a number of tasks, and is good value at around £150, but only prints to a width of 4.5in. Slightly more expensive but much better in terms of quality is the black-and-white Seikosha GP-80, which also

(continued on next page)

BBC

The BBC Micro, which has an excellent ROM-based word processor called View. The BBC Micro is the best home computer for word processing, but it also happens to be the most expensive. View has a number of features which can only be found on word processors for the more expensive micros.

View costs £60 and lives in 16K of ROM. Although it can be used on its own with a cassette player, it is better suited to a disc-based system which makes it fairly expensive. To use it with a printer also requires a special driver program which will set you back a further £10. View can be used with the BBC Micro in a number of modes, which affects radically the number of characters seen on the screen at any moment and the amount of text that can be held in memory.

The BBC Micro is well-suited to word processing, having a real keyboard with a whole raft of function keys. It also has a real typewriter feel, which makes touch-typing not only possible, but easy. The 80-column screen display available in mode 3 is an excellent bonus, but it does have associated disadvantages. It only leaves you with 10K of memory space to play with, which is not a lot of text. Furthermore, to use the 80-column screen without causing permanent eye-strain requires the extra expense of a good monitor. Luckily a monochrome one will do the job.

View allows continuous processing, when used with discs. This allows the user to continuously update a file held on that disc, leaving both the original copy and the final copy on that disc. It also allows the user to create macros. These are effectively multiple instructions which allow the user to define a whole group of instructions by a single instruction.

LYNX, ORIC AND ATOM

The Lynx is eminiently suited to word processing and in fact that could become its main usage when the disc unit and CP/M become available on the micro. The world's biggest-selling word-processor is Wordstar and that should be up and running on the Lynx before long. An interesting feature of the Lynx that may enhance its ability as a word processor is its soft screen. However, the return key is in the wrong place and there have been troubles with the printer interface.

Oric

The 48K Oric is better suited to word processing than the Spectrum, mainly because of its keyboard. The keys are harder than those of the Spectrum which gives it a better feel, though it is still not as good as a proper keyboard as found on the BBC or the Vic-20. However the Oric does have an ersatz space-bar which together with the audio feedback given by the micro does enable an approximation of touch-typing.

The separate cursor keys are again helpful for moving around the screen. The 40-character screen width is a plus, but the characters are of lower resolution than the Spectrum. The worst feature of the Oric as a word processor is that it is difficult to get a high-quality image on the screen. *Your Computer* contributor Dr John Dawson explains on page 76 how he is writing an Oric word processor called Author.

Acorn Atom

The Acorn Atom was the first cheap computer to have a word processor. At only £30 the Atom Wordpack was ahead of its time. It is based in ROM rather than on tape and simply fits into the main board of the Atom. The package is very good, and is helped by the Atom's good keyboard.

(continued from previous page)
happens to be the Vic printer and the Acorn Atom printer. This produces a dot-matrix output which is suitable for just about anything a home word processor will ever print. The Oki-Microline printer also falls into this category.

At around £200 this gives a high enough quality of print for us to accept letters and articles written using them. They are also suitable for students to use when writing essays, but could only be used as a commercial printer by the tiniest of businesses.

Above the Seikosha and Oki comes the Epson range of printers and these really are superb. They are capable of producing output in a number of sizes and widths, and some of them can even produce text in a number of different typefaces. They also allow expanded and condensed print. Used with certain word-processors they have proportional spacing.

Proportional spacing occurs when the number of characters sent to a line by the computer is not enough to fill it. If nothing was done the right edge of the column would look ragged. To compensate, most cheap word processors just distribute extra spaces between the words to fill the line. With proportional spacing that extra space is evenly distributed between the characters in a word and those interword spaces.

At around £300 the Epson RX-80 is probably the best investment you could make if you are considering getting down to some home word processing. One particular good feature is that the printer has a double-strike mode where a character is printed twice with the print-head just slightly displaced to get a better character.

Back-up memory is a vexing problem to the home computer user, and even more so to the home word processor. For a long time we have been waiting for a cheap, reliable and fast memory-backing medium to replace cassette tapes, which amongst other problems are slow. For most purposes cassette tape is the only option open to the home user.

Microdrives and microfloppy disc drives will be a great help because a lot of word processing is to do with pulling phrases from one document and sending them to another, a task eminently suited to disc.

You will need at least 16K of RAM before you can even think of word processing. A character takes up a minimum of one byte, so even if there are no overheads in terms of memory use, and the word-processing software takes no RAM, the maximum size document would be around 16,000 characters or 2,500 words.

The three packages for the Spectrum all require a minimum of 48K RAM. Wordcraft for the Vic-20 is in ROM but it still requires an additional 8K of RAM — which is supplied — to run. Typically Wordcraft allows about 1,000 words and the Spectrum programs allow around 5,000 words. View, the BBC word-processor allows around 4,000 when in mode 7 and 1,500 in mode 3. The cheaper Gemini word-processing package allows about 1,000 words to be typed into the BBC Micro.

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Microdeal	41 Truro Road, St Austell, Cornwall. 0726-67676.
Microl	31 Burleigh Street, Cambridge, CB1 1DG. 0223-312453.
Quicksilva	13 Palmerston Road, Southampton.
Tasman	17 Hartley Crescent, Leeds Software LS6 2LL.
Viza Software	9 Mansion Row, Brompton, Gillingham, Kent ME7 5SE. 0634-813780.

Some micro displays are not capable of handling lower-case and capital letters, though you may want to use both in your document. In that case capitals are usually indicated on the screen by reversing that character space to black on white, or perhaps some other colour.

On other systems the reversed characters might indicate that the characters are to be printed in a different size, or that they are different typefaces. The resolution of the screen — that is, the total number of pixels available to make up the various characters — is also important. On the Spectrum each character cell is eight by eight pixels. On the Oric it is merely six by eight. This means that the characters on the Spectrum look clearer.

If the character cell is too small then descenders are not possible. These are the parts of a character that go below the character line, for example the tail of g and y. If descenders are not possible then the text can be very difficult to read.

It is best to use a television that can be easily moved to the most comfortable viewing position, because backache and neck-strain are just as serious problems as eye-strain. It is important not to sit too near a television set for a long time. The minimum safety margin is to take half an hour off for every one and a half hours working and never work for more than six hours at a stretch.

Choosing a suitable printer for your word processor is one of the most difficult decisions to make. The quality and look of your printed output will in many cases make more of an impression on those you wish to communicate with than what you write. Just imagine if Chamberlain had come back from Munich with a scrap of ZX printout declaring "peace in our time", or if Shakespeare only had a copy of Julius Caesar printed without real descenders when he was trying to raise the production capital.

There are a number of possible choices of printer but for the most part you will be restricted by cost and compatibility. In most cases a good quality printer will cost substantially more than the micro that drives it. The compatibility is important, for example the Sinclair printer only works with Sinclair micros and Sinclair micros will not work with other printers without extra hardware. ■

CONCLUSIONS

- When looking for a word processor for your micro remember the following points.
- Interfacing your micro to a suitable printer is not always easy. Investigate the possibilities before spending money on software.
- Before buying a package let someone demonstrate it to you. Check that you really do find it easy to use, ask awkward questions.
- If you do not have a micro already, but want word processing, look for a real keyboard, a wide screen display, and a Centronics-type printer interface.
- If you intend to do a lot of serious word-processing then the hardware you purchase must take this into account.

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Figure 1. The instructions in lines 444 to 456 are inserted into the program during assembly by the macro command in lines 667 and 670. The variables,]1,]2, and]3 are replaced by the addresses following the Fill name.

```
: L 6 6 6 , 6 7 3

  666
  667 CLS      >>>  FILL.TOP;END;SPACE
  668          RTS
  669
  670 CLTOP    >>>  FILL.TOP;ONE;SPACE
  671          RTS
  672
  673

: V I D E O 3

:

: P R # 1

: L 4 4 3 , 4 5 8

  443
  444 FILL     MAC
  445          LDA  ]1
  446          STA  SD+12
  447          LDA  ]1+1
  448          STA  SD+13
  449          LDA  ]2
  450          STA  SD+14
  451          LDA  ]2+1
  452          STA  SD+15
  453          LDA  ]3
  454          STA  SD+11
  455          JSR  FILLSR
  456          <<<
  457
  458
```

Figure 3. BlockRR reads a named file of text from tape and inserts the text into the Author text already in memory at the position of the cursor. By using existing subroutines and macro-commands it took less than one hour to write a powerful and very useful word-processing command. The modular structure makes the program easy to construct and debug.

```
: L 6 5 , 8 8

   65
   66
   67 BLOCKRR   >>>  PR
   68           JSR  CLTOP
   69           >>>  MES.BCKRMO
   70           >>>  GCR
   71 BCK1      JSR  PUTNAME
   72           JSR  GETLINE
   73           LDA  ICHAR
   74           CMP  ESC
   75           BEQ  BCK1
   76           JSR  MOVENAME
   77           >>>  MES.RTAPMO
   78           >>>  GCR
   79           >>>  SET.MOVBUF;TAPEST
   80           JSR  INITVIA
   81           JSR  RTEXT
   82           JSR  RESETVIA
   83           JSR  FINDEOT
   84           JSR  TOSR
   85           JSR  CUHOME
   86           >>>  PRZ
   87           RTS
   88

: V I D E O 3
```

The perils of cross-assembly are detailed here by John Dawson as he recreates the birth of Oric's word processor.

THIS IS about three computers, six months hard labour, and a word processor called Author. When asked to write the Oric word processor, I had just completed work on a similar program — Asimov — for the Tangerine computer and, thinking rashly that there could not be all that many differences between two machines from the same stable, I agreed.

It seemed that the overall design of the program could stay unchanged: the typewriter approach to writing a text and the editing functions were popular, and other features such as the word count and electronic card index were all about right. I had never been particularly happy with the method of controlling the printer in Asimov and intended to extend and rewrite that section of the program. Printers are a difficult peripheral device to deal with as there is little standardisation of control codes in relation to their various functions. You can plan usually that Control M will perform a carriage return at the end of a line, but will you also need to send a line feed character? If you have a Prism 80 in right-hand justification mode you must not send either a carriage return or a line feed.

Asimov was written on the Tangerine using an ordinary two-pass assembler and cassette tape for storing the source code. At the end of the development stage, when the program, the object code, was nearly 8,000 bytes long, the source code was approximately 40 Kbytes in length. It took seven or eight minutes to store or load the source code from tape, even at the fast 2,400 Baud speed. The program was too big to assemble from the memory as there was insufficient room for the symbol table, object code and source code in RAM at the same time. I had to assemble the program from tape, making two seven-minute passes of the source code before storing the machine code on tape and blowing two 4K EPROMS. In all, it was taking half an hour to modify or extend the program — even to alter one byte or instruction. It was all too slow and unproductive. Developing a new word processor for the Oric in these conditions was going to be impossible.

I started to type the source code into an Apple II using the Merlin macro-assembler from Pace Software. Macro-assemblers contain a number of features that increase the

Figure 4. Oric internal subroutines.

Get character from keyboard	$ C5F8
Print character in accumulator	$ F57B
Initialise VIA for use in tape routines	$E6CA
Save data on tape	$ E57B
Retrieve data from tape	$E4A8
Reset VIA after tape load or save	$ E804
Tape Speed change location FAST 00 SLOW 01	$ 67
Caps lock set or Reset Bit 7 lin location	$ 20C
Bit 7 = 0 Caps lock off	
All subroutines must be reckoned to corrupt all CPU registers.	

AUTH

AUTH

speed of software development, give good structure to the program you are writing, and allow simple alterations that run throughout your source code when you are getting rid of bugs. A section of the program is shown in Figure 1 to illustrate the use of one macro instruction for two purposes. The >>> brackets are the pseudo-operation — not part of the 6502 instruction set but recognised by the assembler as a command to do something — for the start of a macro-instruction. Fill is the name of the macro and the three words following the name are parameters that are passed into the macro to configure the sequence of instructions for a particular purpose. CLS is a subroutine that clears the screen of the VDU by filling the screen with Space characters from the Top — top left-hand position — to End — bottom right-hand position. The same macro can be used to clear the top line of the screen only — CLTop — or to clear the entire text area that will be used by Author by changing the parameters to the start of text and end of text area addresses, and using a Null instead of a Space character.

Figure 3 shows the extensive use of macro commands and subroutines to construct an editing command. There are two great gains; first a vast amount of repetitive typing is avoided as the instructions that make up the macro need be typed once only at the beginning of the program. Consequently, you

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HOR!

will make fewer mistakes. Secondly, if the algorithm that you have used for the macro instruction, the sequence of operations that will achieve the function you wish, is incorrect than it will be wrong throughout and you will find it quickly. Correction is easy and need be done once only in the definition of the macro at the front of the program.

Half way through typing in all the source code I suddenly remembered that the Merlin package includes a disassembler. Disassembling familiar object code to recreate the source program was surprisingly difficult even with a version of the original printout to refer to, but it worked and after I had changed all the zero page locations expressed as absolute hexadecimal addresses back to labels I had a working Asimov source on the Apple.

So far so good. I could blow EPROMs on the Apple and plug them into an expansion board on the Tangerine to check the success of what was now a version of Author running on the Tangerine. But how to get the program into the Oric and how to convert the program for the different input and output conditions on the Oric? The Tangerine uses a line length of 32 characters and displays 16 lines on the VDU. The scren starts at 200 hexadecimal and is just 256 bytes in size. In contrast, the Oric has a standard teletext or Prestel format screen which is 40 characters by 25 lines — 1000 characters — starting at BB80 hex. Unlike the Tangerine, the Oric has an interrupt-driven cursor, something I had added in Asimov, and uses many of the available control codes for colour information — Appendix C in the Oric instruction manual. The more I read the Oric manual, the more impressed I became with the hardware and firmware of the computer and the more despondent about the chances of successfully transferring the program.

Eventually, it seemed that brute force was the only way. The Oric computer did, after all, use the same CPU and if alphanumeric characters were put in the screen RAM area they should be displayed on the VDU. Tansoft gave me the basic subroutine addresses to get a character from the keyboard, store and retrieve data using cassette tape, and the relevant zero page locations. With these subroutines it is possible to take over the computer and make it to behave as you wish — figure 4.

The only way to get a program into the Oric at present is by way of the cassette interface. The Tangerine tape format is the same as the Oric and it is possible to set up a program in the Tangerine that will mimic an Oric tape.

The cassette output from the Tangerine must be amplified before it will drive the cassette input on the Oric and I used a cheap battery-driven telephone amplifier between the two computers. This avoided having to record the tape output from the Tangerine and then load it into the Oric.

The telephone amplifier also revealed a more serious problem. I thought that the Oric was touchy about the volume setting when it was loading a program. The Tangerine never produced any problems even at 2400 Baud and I was surprised when the Oric would not load over the same uncritical volume setting. When I plugged the input of the Oric into the extension speaker socket of the telephone amplifier the speaker emitted a noticeable 50HZ mains hum. Disconnecting the Microvitec colour monitor from the Oric stopped the hum and the arbitrary errors that I had encountered in transferring data from the Tangerine to the Oric also stopped. Clearly I had produced a "hum loop" somewhere in the connections between the computer. Eventually I used a Ferguson 3T07 cassette recorder to record the output from the Tangerine at the same time as it was sent to the Oric. This recorder amplifies the input signal and puts it on to the extension speaker socket while it is recording. In this way it is possible to transfer a program from one machine to another by leaving the cassette input of the second machine plugged into the speaker socket.

I found it necessary to make use of a zero insertion force socket on the end of an 18-inch ribbon cable for loading EPROMs into the Tangerine RAM before the program is sent to the Oric. The program has now gone through approximately 90 versions and it would be impossible to insert the EPROMs into ordinary sockets that many times without damaging the connecting pins. I think that some of the EPROMs are beginning to get "sticky", that is, the chip cannot be programmed properly. The manufacturers data sheets do nopt say how many program/erase cycles an EPROM can be taken through before it ceases to hold its charge effectively.

The high spot of the last six months work went almost unnoticed. I had got the main command level message — illustration 3 — and the Write function assembled and transferred correctly. The "Destroy old text" message came up correctly and then the screen said "Write a new text". I started typing the standard rent-a-word message used by poor typists the world over "Now is the time for all good men to come to the aid of the party" and only at the end, to my amazement and delight, did I notice that the wordwrap routines, part of Asimov that delayed me for at least a month, had worked without fault.

What does all this prove? It is possible to cross-assemble a program on one microcomputer for it to run on an entirely different machine. This applies to the BBC micro as well as the other commonly available 6502 based computers. In the Z-80 family there is no reason why a Nascom should not assemble machine code for the Spectrum or the MZ-80K, or vice versa. The Apple and the Merlin assembler has proved an excellent development machine. Merlin is a professional assembler allowing fast program development and the assembly of major machine code programs. Transferring programs from one machine to another is still a hit and miss affair — there is no standardisation. I could have bought an RS-232 interface board for the Apple and written the software to link the Apple and the Tangerine directly rather than using EPROMs as the method of transferring Author. If you decide to use an assembler to produce a machine code program for some purpose, do not expect instant results, but at the same time do not expect to write a neat, fast program that will take over a foreign machine by using Basic. ■

Figure 2. Author is a large machine-code program. The Put pseudo-op in the Merlin assembler reads a source code file into memory, assembles the object code and then reads the next source code file, overwriting the previous file. In future disc-based versions it will be easy to replace the Tape module.

```
  V I D E O 3
: L 9 4 8 , 9 6 2
  948
  949
  950          PUT  WRITE
  951
  952          PUT  EDITOR
  953
  954          PUT  MESSAGES
  955
  956          PUT  TAPE
  957
  958          PUT  PRINT
  959
  960          PUT  DATAFILE
  961
  962
: V I D E O 3
```

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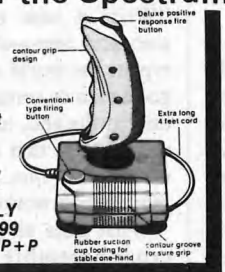

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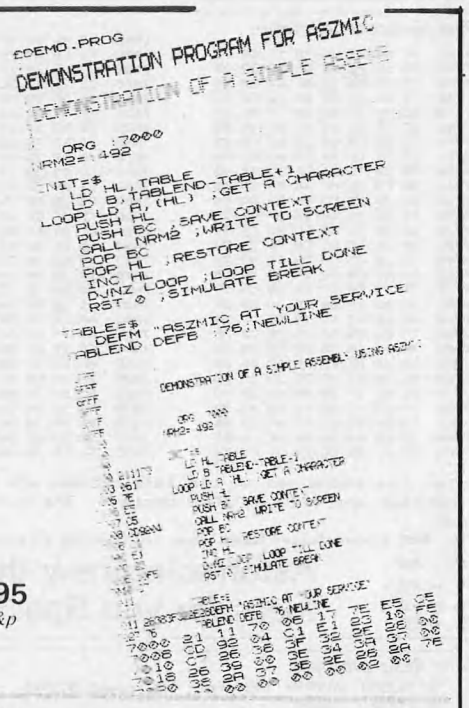

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3D

IF YOU have ever seen the arcade game Battlezone you may have wondered if such graphics were possible on the Spectrum. This machine-code utility for both 16K and 48K machines allows you to draw a 3-D figure on the screen with reference to fixed X, Y, Z axes. The whole process takes at most 0.5 seconds for complicated figures and under 0.25 seconds for simple figures such as cubes. Each figure can be rotated in all three axes, and moved away from and towards you with full perspective; it can also be moved up, down and sideways. Any part of the figure partially off the screen is accounted for in a special Draw routine written for this program. All this can be called from Basic with just one simple Usr instruction.

The program has various modes. To alter the mode Poke the appropriate number into the mode location.

Mode 1 CLS and then carries out draw routine.
Mode 2 carries out draw routine alone.
Mode 3 replaces screen with spare screen stored at location specified in Spscreen then carries out draw routine.

Also global Inverse 1 will set the routine to Unplot rather than Plot. Inverse 0 returns it back to plot. Thus to draw a figure and then undraw it again you might use the following program.

Astonishing new three-dimensional graphics ideas for you Spectrum from Mark Jones.

The hexadecimal dump.

```
7918  3E 80 32 E8 7B 11 00 01
7920  2A D8 7B CD 55 79 22 D8
7928  7B 22 E6 7B AF 32 E8 7B
7930  11 00 00 2A D4 7B EB CD
7938  55 79 11 80 00 CD B2 79
7940  22 D4 7B 11 57 00 2A D6
7948  7B D5 CD 55 79 D1 CD B2
7950  79 22 D6 7B C9 AF EB ED
7958  52 CB 7C C4 C2 79 44 4D
7960  3A E8 7B 8F 38 04 ED 4B
7968  E6 7B E5 C5 EB 21 00 00
7970  CD 9C 79 30 16 AF E1 D1
7978  BC 20 01 EB CD 93 79 44
7980  4D 21 00 00 CD 9C 79 CD
7988  93 79 C9 06 08 CD 95 79
7990  D1 D1 C9 06 04 CB 3C CB
7998  1D 10 FA C9 CB 38 CB 19
79A0  30 02 19 D8 2B 06 EB 29
79A8  D8 EB 18 F0 7B FE 00 C8
79B0  18 F4 EB 3A E8 7B CB 3F
79B8  30 05 19 32 E8 7B C9 ED
79C0  52 C9 D5 EB AF 67 6F ED
79C8  52 3A E8 7B 3C 32 E8 7B
79D0  D1 C9 1F 30 0F 01 5A 00
79D8  09 E5 01 68 01 ED 42 38
79E0  02 C1 E5 E1 E5 AF 01 B4
79E8  00 ED 42 38 04 3E 01 C1
79F0  E5 E1 32 E8 7B 01 F2 7B
79F8  09 4E 06 00 ED 43 E6 7B
7A00  EB CD 59 79 C9 C5 E5 F5
7A08  CD D2 79 3A E8 7B 1F DC
7A10  C2 79 F1 3C D1 C1 F5 E5
7A18  EB 50 59 CD D2 79 3A E8
7A20  7B 1F DC C2 79 D1 F1 1F
7A28  30 02 19 C9 EB ED 52 C9
7A30  2A E2 7B ED 5B D4 7B ED
7A38  4B D8 7B E5 D5 C5 3E 01
7A40  CD 05 7A 22 D4 7B C1 D1
7A48  E1 AF CD 05 7A E5 C1 2A
7A50  E0 7B ED 5B D6 7B E5 D5
7A58  C5 AF CD 05 7A 22 D8 7B
7A60  C1 D1 E1 3E 01 CD 05 7A
7A68  E5 C1 2A E4 7B ED 5B D4
7A70  7B E5 D5 C5 3E 01 CD 05
7A78  7A 22 D4 7B C1 D1 E1 AF
7A80  CD 05 7A 22 D6 7B C9 2A
7A88  D4 7B ED 5B EE 7B 0E 01
7A90  AF ED 52 CB 7C 28 06 26
7A98  00 95 6F 0D 0D 45 C5 2A
7AA0  D6 7B ED 5B F0 7B 06 01
7AA8  AF ED 52 CB 7C 28 04 95
7AB0  6F 05 05 D1 4A 50 45 D9
7AB8  E5 D9 79 B8 30 06 69 D5
7AC0  AF 5F 18 08 B1 28 3B 68
7AC8  41 D5 16 00 60 7B 1F 85
7AD0  38 03 BC 38 07 94 4F D9
7AD8  C1 C5 18 04 4F D5 D9 C1
7AE0  2A F0 7B 79 48 05 28 01
7AE8  04 09 22 F0 7B 2A EE 7B
7AF0  4F 47 05 28 01 04 09 22
7AF8  EE 7B CD 06 7B D9 79 10
7B00  CE D1 D9 E1 D9 C9 AF 2A
7B08  EE 7B BC C0 4D 2A F0 7B
7B10  BC C0 3E AF 95 D8 47 CD
7B18  B1 22 47 04 3E 01 0F 10
7B20  FD 46 FD CB 57 5E 28 04
7B28  2F A0 77 C9 B0 77 C9 3A
7B30  E9 7B 1F 30 19 1F 01 00
7B38  18 11 00 40 30 07 2A EA
7B40  7B ED B0 18 09 21 CB 24
7B48  2B ED A0 EA 48 7B ED 4B
7B50  D2 7B 2A EC 7B C5 AF 57
7B58  5E CB 7B 28 01 15 ED 53
7B60  D4 7B 57 23 5E CB 7B 28
7B68  01 15 ED 53 D6 7B 57 23
7B70  5E CB 7B 28 01 15 ED 53
7B78  D8 7B 23 E5 CD 30 7A ED
7B80  5B DA 7B 2A D4 7B 29 19
7B88  22 D4 7B ED 5B DC 7B 2A
7B90  D6 7B 29 19 22 D6 7B ED
7B98  5B DE 7B 2A D8 7B 19 22
7BA0  D8 7B CD 18 79 E1 7E 23
7BA8  E5 1F 38 11 2A D4 7B 22
7BB0  EE 7B 2A D6 7B 22 F0 7B
7BB8  CD 06 7B 18 03 CD 87 7A
7BC0  E1 C1 10 91 C9
```

Note: the addresses in the left column are given in hexadecimal. Eg: 7918 = 3100 0 decimal and 7920 = 31008 decimal. The final address, 7BC4, equals 31684 in decimal.

For 48K conversion make the following changes to the underlined numbers

16K	48K
79	= F5
7A	= F6
7B	= 7C

The Basic program.

```
   2 CLEAR 30999: REM for 48K read 62743
   3 LOAD ""CODE
   5 LET px=10: LET py=40: LET pz=50
   7 LET phi=0: LET psi=0: LET theta=0
  10 GO SUB 1910: GO SUB 4000: GO TO 2000
  13 REM TANK DATA
  14 REM body
  15 DATA -7,5,-26,0,-7,0,-18,1,-7,0,9,1,-7,4,12,1,-7,8,12,1,-7,8,-10,1,-7,8,-13
,1,-7,5,-26,1
  17 DATA 7,5,-26,1,7,0,-18,1,7,0,9,1,7,4,12,1,7,8,12,1,7,8,-10,1,7,8,-13,1,7,5,
-26,1
  18 REM turret
  19 DATA -7,0,-18,0,7,0,-18,1,-7,0,9,0,7,0,9,1,-7,8,-13,0,7,8,-13,1,-7,8,-10,0,
7,8,-10,1,5,13,-2,1,-5,13,-2,1,-7,8,-10,1,-7,8,12,0,7,8,12,1,5,13,4,1,-5,13,4,1,
-7,8,12,1,-5,13,-2,0,-5,13,4,1,5,13,-2,0,5,13,4,1
  20 REM barrel
  21 DATA 2,12,-25,0,-2,12,-25,1,-2,10,-25,1,2,10,-25,1,2,12,-25,1,2,12,-4,1,-2,
12,-4,1,-2,10,-7,1,2,10,-7,1,2,12,-4,1,-2,12,-25,0,-2,12,-4,1,-2,10,-25,0,-2,10,
-7,1,2,10,-25,0,2,10,-7,1
  99 REM CUBE DATA
 100 DATA 20,-20,20,0,20,-20,-20,1,-20,-20,-20,1,-20,-20,20,1,20,-20,20,1,20,20,
20,1,20,20,-20,1,-20,20,-20,1,-20,20,20,1,20,20,20,1,20,-20,-20,0,20,20,-20,1,-2
0,-20,-20,0,-20,20,-20,1,-20,-20,20,0,-20,20,20,1
 200 IF v<0 THEN LET v=65536+v
 210 LET a=INT (v/256): LET b=INT (256*(v/256-a))
 220 POKE d,b: POKE d+1,a
 225 LET d=d+2
 230 RETURN
1900 RESTORE 100: LET v=16
1901 GO TO 1920
1910 RESTORE 15: LET v=50
1920 GO SUB 5000
1930 RETURN
2000 IF INKEY$="" THEN GO TO 2000
2001 IF INKEY$="v" THEN CLS : GO TO 2000
2002 IF INKEY$="c" THEN GO SUB 1900
2003 IF INKEY$="t" THEN GO SUB 1910
2005 LET a$=INKEY$
2010 LET px=px+10*(a$="5")-10*(a$="8")
2020 LET py=py+10*(a$="u")-10*(a$="d")
2030 LET pz=pz+10*(a$="7")-10*(a$="6")
2040 LET theta=theta+10*(a$="y")-10*(a$="Y")
2050 LET psi=psi+10*(a$="z")-10*(a$="Z")
2060 LET phi=phi+10*(a$="x")-10*(a$="X")
2070 IF a$>="1" AND a$<="3" THEN POKE 31721,VAL a$
2080 IF theta>360 THEN LET theta=theta-360
2090 IF psi>360 THEN LET psi=psi-360
3000 IF phi>360 THEN LET phi=phi-360
3010 IF theta<0 THEN LET theta=360+theta
3020 IF phi<0 THEN LET phi=360+phi
3030 IF psi<0 THEN LET psi=360+psi
3040 IF pz>256 THEN LET pz=256
3050 GO SUB 4000
3060 GO TO 2000
4010 LET v=px: LET d=31706: REM for 48K read 63450: GO SUB 200: LET v=py: GO SUB
 200: LET v=pz: GO SUB 200
4015 LET d=31712: REM for 48K read 63456: LET v=phi: GO SUB 200: LET v=theta: GO
 SUB 200: LET v=psi: GO SUB 200
4020 RANDOMIZE USR 31535: REM for 48K read 63729
4030 RETURN
5000 PRINT AT 0,0;"please wait a moment": FOR f=1 TO v: READ x,y,z,p
5001 IF x<0 THEN LET x=x+255
5002 IF y<0 THEN LET y=y+255
5003 IF z<0 THEN LET z=z+255
5010 POKE 31996+f*4,x: POKE 31997+4*f,y: POKE 31998+4*f,z: POKE 31999+4*f,p: NEX
T f
5011 REM for 48K read 63740 - 63743 instead of 31996 - 31999
5015 POKE 31699,v: REM for 48K read 63443
5016 PRINT AT 0,0;"                    "
5020 RETURN
```

SPECTRUM

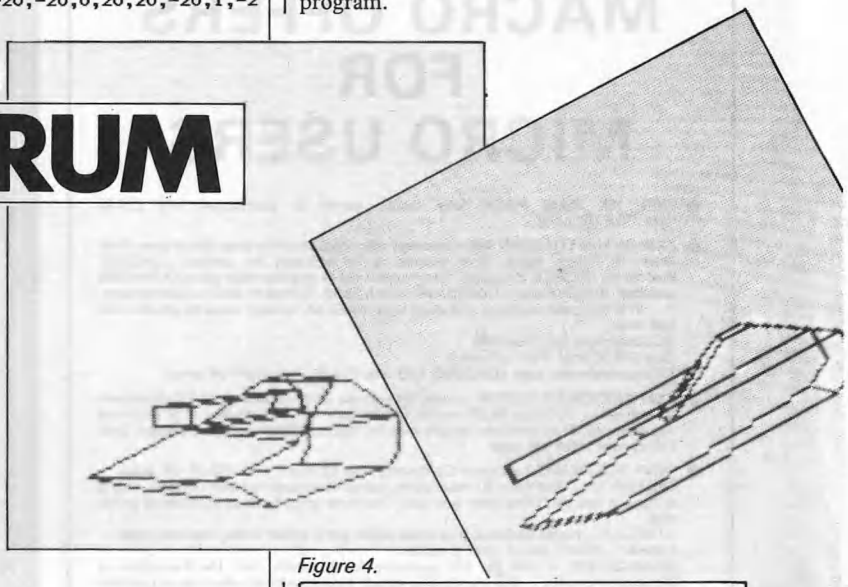


Figure 4.

Point	X co-ord	Y co-ord	Z co-ord
a	20	-5	10
b	20	-5	-10
c	-20	-5	-10
d	-20	-5	10
e	-20	5	10
f	-20	5	-10
g	20	5	-10
h	20	5	10

GRAPHICS

```
10 INVERSE 0
20 RAND USR 31535 (16K) 63729 (48K)
30 INVERSE 1
40 RAND USR 31535 (16K) 63729 (48K)
```

If, when you have typed in the whole program, you try out this routine for unplotting, you will find it quite slow for complicated figures. Hence modes 1 and 3. CLS is much faster than the time it takes to unplot a figure. Copying a spare screen, say a background scene, is also faster than deleting the figure by unplotting.

Position and direction of the object are stored in the variables PX, PY, PZ, Theta, Phi, and Psi.PX is positive to the left of the centre of the screen, PZ is positive in front of you and negative behind you. Infinity is at PZ=256, that is, the figure is just a dot. If you then decrease PZ the object will get larger and larger until it eventually goes past you and disappears out of your sight. Altering PY simply moves the object up and down relative to you, the observer.

Theta, Phi and Psi should all be in the range 0 to 359 degrees. Altering Theta gives rotation in the Y axis, altering Phi gives rotation in the X axis, and altering Psi gives rotation in the Z axis. See figure 1.

All the variables PX, PY and PZ are stored as the complement numbers, that is, the negative form of the number is

65536 + number

I provide a routine — Gosub 200 — for storing such numbers. Theta, Phi and Psi are stored as two-byte numbers.

One of the most long-winded parts of creating any 3-D figure is calculating the XYZ co-ordinates for its data. Such data can be stored in any way you wish but must, ultimately, be transferred to somewhere in memory as bytes. The position of the data is specified in the variable Addr. These bytes should be in the range from minus 128 to 127.

Each location is in fact specified by four parameters, X, Y, Z and P. P specifies whether to plot

P=0

or to draw

P=1

a line from the last point plotted to this current point. I provide a routine to transfer data to a position in memory from Data statements.

It helps you if, when you create your own 3-D figures, you are extremely methodical. I use the following technique: first, sketch your figure in 3-D and label each point as shown in figure 2. Then draw on graph or squared paper a plan view and side elevation of your figure and again label all the points seen and unseen, as shown in figure 3. Next, draw in where you wish the axes to be; it is usual for them to be in the centre of the figure, otherwise rotations have the effect of making the object look odd.

Using the graph paper work out the distance of each X point along the X axis, positive or negative and record this in a table. Repeat this step for the Y and Z axes. See figure 4.

The next step is to decide in what order you are going to draw the lines. Use your 3-D sketch to decide this. Remember that you can move your plot position around so that you do not have to draw the figure with just continuous draw commands. If

a0 = plot a point at a

and

a1 = draw a line from the last plot position to a

then choose the following route to draw the box;

a0 b1 c1 d1 a1 h1 e1 f1 g1 h1

We have now come to the end of this route in that any further draws will simply overplot lines already drawn.

We now plot again at a different location and draw one line. We repeat this three times for the three undrawn sides, that is:

d0 e1, c0 f1, b0 g1

Now enter the data co-ordinates you have calculated for each point in the order specified by your route. Remember to follow each set of co-ordinates with 0 or a 1 for a plot or a draw. Next, using the loader at subroutine 5000 enter the data into memory. On entry to the routine v is equal to the number of points to be stored. Finally, run the program and view your figure from any direction any angle.

Though my method for calculating points may have seemed unnecessary for a simple figure like a box it is a worthwhile technique

(continued on next page)

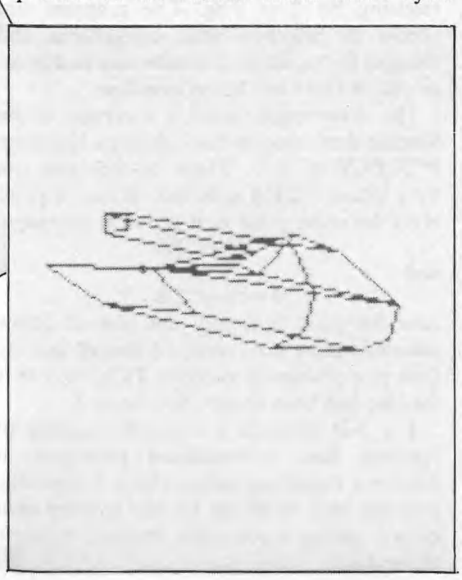


Figure 1.

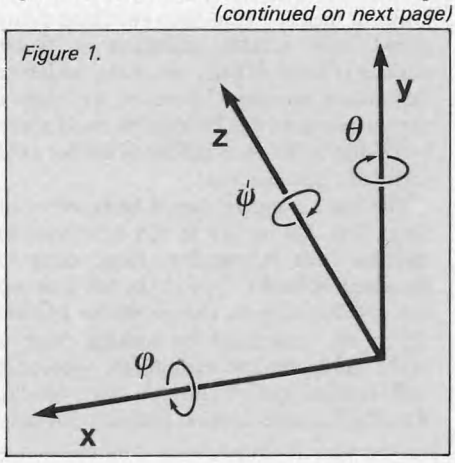


Figure 2.

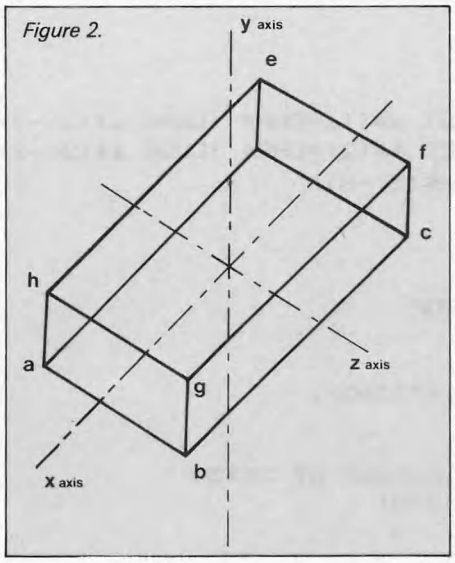


Figure 3.

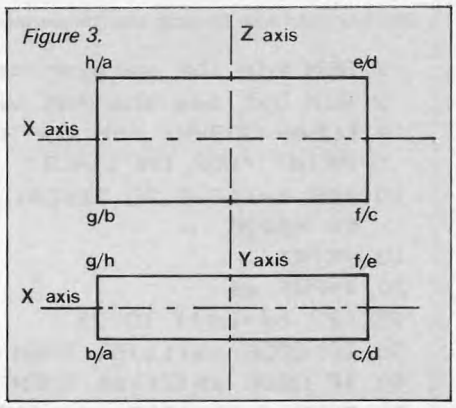
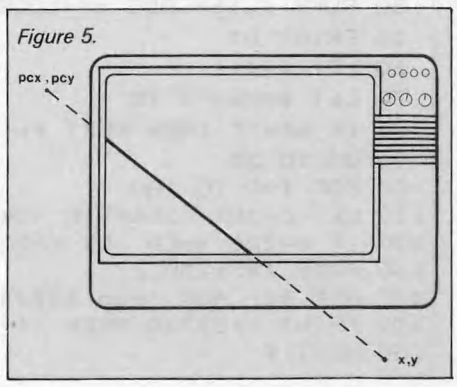


Figure 5.



(continued from previous page)

to get into the habit of using, particularly when you move on to much more complicated figures.

The Basic program contains data for a tank similar to that in Battlezone and also data for a cube. The program allows you to completely control all aspects of the figure's position and angle. It also allows you to alter mode and switch figures between tank and cube.

5 = move left.
6 = move away from you.
7 = move towards you.
8 = move right.
y = rotate positive in y axis.
Y = rotate negative in y axis.
x = rotate positive in x axis.
X = rotate negative in x axis.
z = rotate positive in z axis.
Z = rotate negative in z axis.
v = CLS.
1 = mode 1.
2 = mode 2.
3 = mode 3.
c = current figure becomes cube.
t = current figure becomes tank.

There is a slight delay between changing figures. This is because both figures are stored in the same memory area. If you were to use different memory areas then switching figures would only require alteration of Numb, number of items of data, and Addr, position of that data in memory. I have set the height of the horizon to be 87. This can be easily altered by Poking 31044 for a 16K or 67288 for a 48K with your new horizon.

The Basic program should be typed in and saved first. Do not try to run it without any machine code in memory. Now, using the hexadecimal loader, type in the hex numbers. For a 48K machine, change all the numbers which are underlined by looking them up in the table given and selecting the appropriate 48K replacement. When you have finished, Run the Sin table creation program. If you are going to store your data using my program then you should set the variable Addr.

16K POKE 31724,0 POKE 31725,125
48K POKE 63468,0 POKE 63469,249

Now Save the code from the start address and length 920 bytes. Having done this load the Basic program and try it all out.

Essentially the program carries various mathematical equations as follows:

Rotation.

Y1 = Y*COS(PHI)-Z*SIN(PHI)
Z = Y*SIN(PHI) + Z*COS(PHI)
X1 = X*COS(THETA)-Z*SIN(THETA)
Z = X*SIN(THETA) + Z*COS(THETA)
X = X1*COS(PSI)-Y1*SIN(PSI)
Y = X1*SIN(PSI) + Y1*COS(PSI)

Translation and Scaling.

X = 2*X + PX
Y = 2*Y + PY
Z = Z + PZ

Perspective.

Z = (256-Z)*(256-Z)/256
X = 128-X*Z/256
Y = 87-Y*Z/256

If you try running a program in Basic applying these equations you will get the same result as my machine-code program but it will be hundreds of times slower. A complicated figure that might take 0.5 seconds in machine code could take over a minute in Basic.

You will notice that the rotation equations require Sin and Cos values. I achieve these quickly by using a look-up table. This table has the numerator of the fraction v/256 stored where v/256 = sin(Alpha). If then we now consider one of the rotation equations again it becomes now:

Y1 = Y*V1/256-Z*V2/256

Each part of the equation is of the same form,

A*B/256

as the perspective equations and so we can use one subroutine for this calculation Calct, saving memory and time. The program keeps a constant tally of whether the current number being processed is positive or negative by examining its highest bit and then setting or resetting Bit 0 of Flag. The program also checks for overflow with calculations and changes the sequence of divides and multiplies to ensure there will be no overflow.

The draw routine used is a version of the Sinclair draw routine but it draws a line from PCX,PCY to X,Y. These co-ordinates can have values -32768 to 32767. If then a point is off the screen, that is, it is not in the range:

0 =< X =< 255

and

0 =< Y =< 175

then the point is simply not plotted. Draw calculations are still continued though and the final plot position is stored in PCX,PCY as if the line had been drawn. See figure 5.

The 3-D program is a simple example of applying basic mathematical principles to achieve a visually attractive effect. I hope this program will be of use to you in your own games, adding a new more exciting dynamic element. ■

Program variables.

		16K	48K
Numb	Number of sets of co-ordinates.	31699	63443
X	Temporary store used by program.	31700	63444
Y	Temporary store used by program.	31702	63446
Z	Temporary store used by program.	31704	63448
PX	Store for translation co-ordinates.	31706	63450
PY	Store for translation co-ordinates.	31708	63452
PZ	Store for translation co-ordinates.	31710	63454
Phi	Angle about x axis.	31712	63456
Theta	Angle about y axis.	31714	63458
Psi	Angle about z axis.	31716	63460
Varst	Variable store used by program.	31718	63462
Flag	Bit 7 indicates that z is being processed.	31720	63464
Mode	As specified. Bit 0 indiciates negative number.	31721	63465
Spscreen	Storage address of spare screen position.	31722	63466
Addr	Address stored here of data position.	31724	63468
PCX	Last x point plotted.	31726	63470
PCY	Last y point plotted.	31728	63472

The hex input and Sin table creation program.

```
  1 REM the 16K version can be run on a 48K Spectrum
  2 REM but use the 48K version to maximise space
  4 CLEAR 30999: REM for 48K read 62743
  5 PRINT "USE CAPITALS"
 10 FOR f=31000 TO 31684: REM for 48K read 62744
    to 63428
 15 PRINT
 20 INPUT a$
 25 LET b$=a$(1 TO 2)
 30 IF CODE a$(1)>64 THEN LET a$(1)=CHR$ (CODE a$(1)-7)
 40 IF CODE a$(2)>64 THEN LET a$(2)=CHR$ (CODE a$(2)-7)
 50 POKE f,16*CODE a$+CODE a$(2)-816
 55 PRINT b$
 60 LET f=f+1
 70 LET a$=a$(3 TO )
 80 IF a$="" THEN NEXT f: STOP
 90 GO TO 25
100 FOR f=0 TO 180
110 LET c=INT (256*SIN (2*PI*f/360))
120 IF c=256 THEN LET c=255
130 POKE f+31730,c
135 REM for 48K read 63474 instead of 31730
140 PRINT f+31730,PEEK (f+31730)
150 NEXT f
```

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CS

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SPACE IN

THIS GAME has 40 deadly manoeuvring Invaders, three laser bases, five defence shields, increasing speed, and an on-screen updated score written completely in machine code to ensure fast and exciting action. The machine code is stored in one long Rem statement which is 810 characters long. Due to the fact that a Rem of this length would be hard to enter direct from the keyboard, try it this way. First, enter the first line:

1 REM @ 94 characters @

Second, create lines 2 to 8 by editing line 1. Third, enter line 9

9 REM @ 10 characters @

Four,

POKE 16512,3
POKE 16511,44

Fifth, enter the rest of the program in listing 1. Listing 2 contains the hex dump of the actual program. This listing is in hexadecimal, explained in chapter 24 of the ZX manual.

It is divided up into sections of 100 units, each preceded by the address of the first unit in both decimal and hexadecimal. There are two ways to start to enter a section of the machine code. To enter the start address in hex, run the program. To enter the start address in decimal you must use the following procedure:

LET X EQUAL THE ADDRESS REQUIRED
GOTO 50

This will have the same effect as entering the address in hex and will be especially useful when it comes to debugging the program.

Any number of the units may be entered at one time but they must be entered as pairs and not single characters. If the program ends with an error code 5/100 it just means that the screen has been filled, but it is essential that Cont is operated or the last units entered may be lost. The program may be saved at any time as long as the next part to be entered is remembered. Otherwise it may take some time to find where you last got to. It is advisable to save the program at several points in case anything goes wrong.

Once all the program has been entered, Save a couple of copies then you are ready to try it out. Type:

RAND USR 17247

This will jump to the start of the machine code and should produce a picture on the screen just like that of the space invaders. If it does, then congratulations. You have managed the near impossibility of entering a machine-code program correctly first time. If not, then I hope that the following information will help you debug it.

First, though, here is how to change the program into its final form. The final form of the program is made by deleting all the lines except the first — it is important that you do not even edit this line as it will result in some code being lost. This is done by entering the line number of the line you wish to replace and then pressing Newline. New must not be

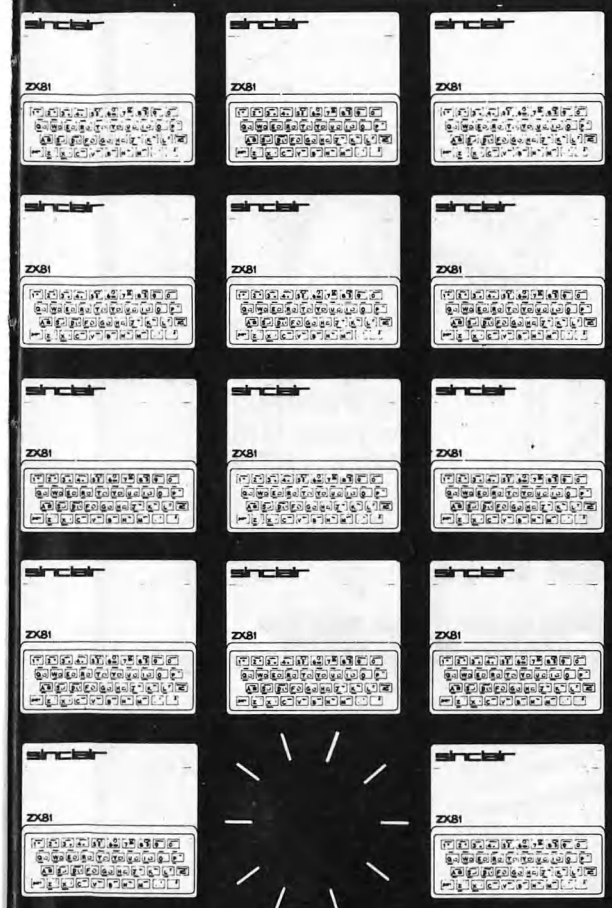
Listing 1.

```
   1 REM @@@@@@@@@@@@@@@@@@@@@@@
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@@@@@@@
   2 REM @@@@@@@@@@@@@@@@@@@@@@@
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@@@@@@@
   3 REM @@@@@@@@@@@@@@@@@@@@@@@
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@@@@@@@
   4 REM @@@@@@@@@@@@@@@@@@@@@@@
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@@@@@@@
   5 REM @@@@@@@@@@@@@@@@@@@@@@@
@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
```

NVADERS

```
0000000000000000000000000000000000
0000000
   5 REM 0000000000000000000000000000
0000000000000000000000000000000000
0000000000000000000000000000000000
0000000
   7 REM 0000000000000000000000000000
0000000000000000000000000000000000
0000000000000000000000000000000000
0000000
   8 REM 0000000000000000000000000000
0000000000000000000000000000000000
0000000000000000000000000000000000
0000000
   9 REM 1234567890
  10 PRINT "WRITE TO  ";
  20 INPUT A$
  30 PRINT A$
  40 GOSUB 200
  50 PRINT
  60 LET A$=""
```

```
  70 IF A$="" THEN INPUT A$
  80 IF A$="S" THEN STOP
 100 PRINT A$( TO 2)
 110 POKE X,16*CODE A$+CODE A$(2
)-476
 120 LET X=X+1
 130 LET A$=A$(3 TO )
 140 GOTO 70
 200 LET X=4096*CODE A$+256*CODE
 A$(2)+16*CODE A$(3)+CODE A$(4)-
122332
 210 RETURN
 300 PRINT "ADDRESS ";
 310 INPUT A$
 320 PRINT A$
 330 GOSUB 200
 340 LET C=PEEK X
 350 PRINT CHR$ INT (C/16+28);CH
R$ (28+C-16*INT (C/16)),X
 360 LET X=X+1
 370 GOTO 340
```



Listing 2.

```
16514 (4082 HEX)
00 06 86 00 06 86 00 06
86 00 06 86 00 06 86 00
06 86 00 06 86 00 06 86
FF 38 28 34 37 2A FF 31
2E 3B 2A 38 FF 00 87 80
04 00 FF 0E 00 00 14 01
00 01 01 00 CD F5 08 21
9B 40 CD 3B 41 01 17 00
CD F5 08 21 A1 40 CD 3B
41 01 00 01 CD F5 08 06
20 CD 35 41 01 00 15 CD
F5 08 06 20 CD 35 41 01
01 04 C5 CD
```

```
16614 (40E6 HEX)
F5 08 21 82 40 CD 3B 41
C1 04 04 3E 0E B8 20 EE
01 00 12 C5 CD F5 08 06
03 CD 35 41 3E 07 C1 81
FE 23 4F 20 EE ED 4B AF
40 CD F5 08 21 A7 40 CD
3B 41 01 1D 00 CD F5 08
3A B1 40 4F 06 00 CD 9B
0A 01 07 00 CD F5 08 ED
4B AD 40 CD 98 0A C9 3E
03 D7 10 FD C9 7E FE FF
C8 D7 23 18 F8 CD B8 02
CB 55 20 2F
```

```
16714 (414A HEX)
ED 4B AF 40 CB 54 20 0A
0D 79 FE FF 20 04 ED 4B
AF 40 CB 64 20 0A 0C 79
FE 1C 20 04 ED 4B AF 40
ED 43 AF 40 E5 CD F5 08
21 A7 40 CD 3B 41 E1 CB
65 20 0D ED 4B AF 40 05
0C 0C CD F5 08 3E 17 D7
C9 2A 0C 40 01 D6 02 C5
E5 E1 C1 3E 17 ED B1 20
43 C5 E5 2B 36 00 11 21
00 ED 52 7E FE 00 20 04
36 17 18 E5
```

```
16814 (41AE HEX)
FE 1B 20 04 36 00 18 DD
FE 03 20 02 18 D7 CB BF
FE 06 2B 06 03 36 00 23
10 FB ED 4B AD 40 03 C5
01 07 00 CD F5 08 C1 ED
43 AD 40 CD 98 0A 18 B5
01 D6 02 C5 E5 E1 C1 3E
1B ED B9 C0 C5 E5 23 36
00 11 21 00 19 7E FE 00
20 04 36 1B 18 E7 FE 17
20 04 36 00 18 DF FE 03
28 DB E6 7F FE 06 28 D5
ED 4B AF 40
```

```
16914 (4212 HEX)
CD F5 08 06 05 3E 08 D7
10 FD 3A B1 40 3D FE 00
28 35 32 B1 40 4F 06 00
C5 01 1D 00 CD F5 08 C1
CD 98 0A 06 FF 10 FE ED
4B AF 40 CD F5 08 06 05
3E 00 D7 10 FD 01 0D 14
ED 43 AF 40 CD F5 08 21
A7 40 CD 3B 41 18 8A C1
C1 C1 01 0B 0B CD F5 08
21 69 42 CD 3B 41 C9 AC
A6 B2 AA B0 B4 BB AA B7
FF 3A B2 40
```

```
17014 (4276 HEX)
CB 67 20 64 2A 0C 40 11
D6 02 19 E5 D5 C1 E1 3E
86 ED B9 20 0D E5 C5 23
54 5D 13 01 03 00 ED B8
18 EB 01 1E 00 CD F5 08
2A 0E 40 11 21 00 3E B6
06 15 BE 28 04 19 10 FA
C9 01 00 10 CD F5 08 2A
0E 40 01 21 00 3E 06 ED
B1 CA 5B 42 3A B2 40 CB
E7 32 B2 40 2A 0C 40 01
31 02 09 54 5D 01 21 00
ED 42 01 CE
```

```
17114 (42DA HEX)
01 ED B8 C9 2A 0C 40 01
D6 02 C5 E5 E1 C1 3E 06
ED B1 20 0D C5 E5 2B 54
5D 1B 01 03 00 ED B0 18
EB 2A 0C 40 23 23 11 21
00 06 15 3E 06 BE 28 04
19 10 FA C9 3A B2 40 CB
A7 32 B2 40 C9 3E 03 F5
CD 44 43 E6 1F 06 11 4F
CD F5 08 2A 0E 40 11 21
00 06 0F 7E E6 7F FE 06
28 0B ED 52 10 F5 F1 3D
FE 00 20 DB
```

```
17214 (433E)
C9 19 36 1B F1 C9 2A 32
40 54 5D 29 29 19 29 29
29 19 22 32 40 7C C9 3E
FF 2A AD 40 95 47 10 FE
C9 3E 03 32 B1 40 21 00
00 22 AD 40 21 0D 14 22
AF 40 CD B3 40 CD BB 41
CD 43 41 CD 55 43 CD BB
41 CD 73 42 2A 0C 40 01
D6 02 3E 06 ED B1 28 03
CD B3 40 CD 44 43 E6 03
3C 47 C5 CD 17 43 C1 10
F9 18 D2 EA
```

```
17314 (43A2 HEX)
1D 1E 1F 20 21 22 23 24
25 1C 76
```

used as it will delete line 1. Once this is done line 10 is entered:

10 RAND USR 17247

The program is now complete and can be saved. It is advisable to keep a copy of the program with the hex loader attached as several modifications are suggested later. The program can now be started by the command Run. The command keys are:

W — left
R — right
0-6 — fire

The hex loader listed in listing 1 has an advantage over some hex loaders because it includes a hex lister from 300. Like the hex loader it will accept starting addresses in either decimal or hexadecimal, except that the address to Goto, if decimal is used, is 340.

If you own a ZX Printer you may find it easier to track down a fault if you take a listing and compare it with that in listing 2. Any difference in the Rem statement is a fault, but it should be possible to approximate where in the program the fault is from its position in the Rem.

For the rest, the only way to do it is to slowly search through the program comparing it with the listing. The hex lister will give the address of the unit being looked at in decimal. Knowing this it will be possible to correct any errors by using the hex loader and addressing it in decimal as I explained earlier.

The program is built up of several subroutines which are called in turn by the main routine, the Driver. These subroutines are: Screen — 40B3 — this routine prints the screen and invaders. Any fault in the screen layout means there is an error here. Keybd — 4143 — this is the routine which finds out which key you are pressing and responds by moving the base or firing a missile.

MVMIS — 418B — this routine moves the missiles up and the bombs down and checks if they have hit anything and adjusts everything accordingly. If the bombs do not move, or the program crashes when the bombs reach the ground then the error is in this routine.

MVINV — 4273 — this routine moves the invaders across and down the screen. If the program crashes when the invaders reach the edge of the screen or disappear on reaching the bottom then the error is here.

DELAY — 4355 — this routine is the one which allows the invaders to increase speed. This is done by repeating a loop a number of times dependent on the score.

Finally, a couple of modifications for those who are never satisfied. The following set of Pokes will reverse the keyboard arrangement:

POKE 16711,109
POKE 16719,92
POKE 16733,76
POKE 16762,93

this make the keyboard layout:

P — right
I — left
1-5 — fire

For those who, unlike me, can get very high scores on these games this one can be made much harder by increasing the number of bombs dropped every time. This is done by the following method:

POKE 17301,7 — To double the difficulty
POKE 17301,15 — To multiply the difficulty by five. ■

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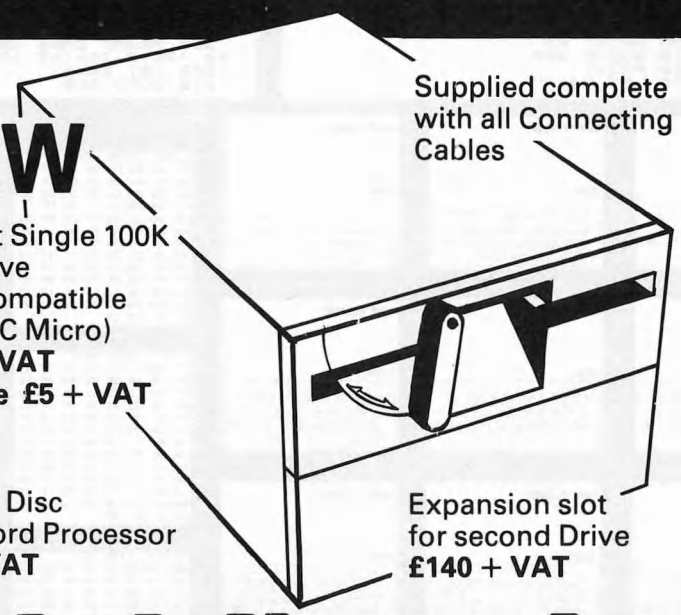

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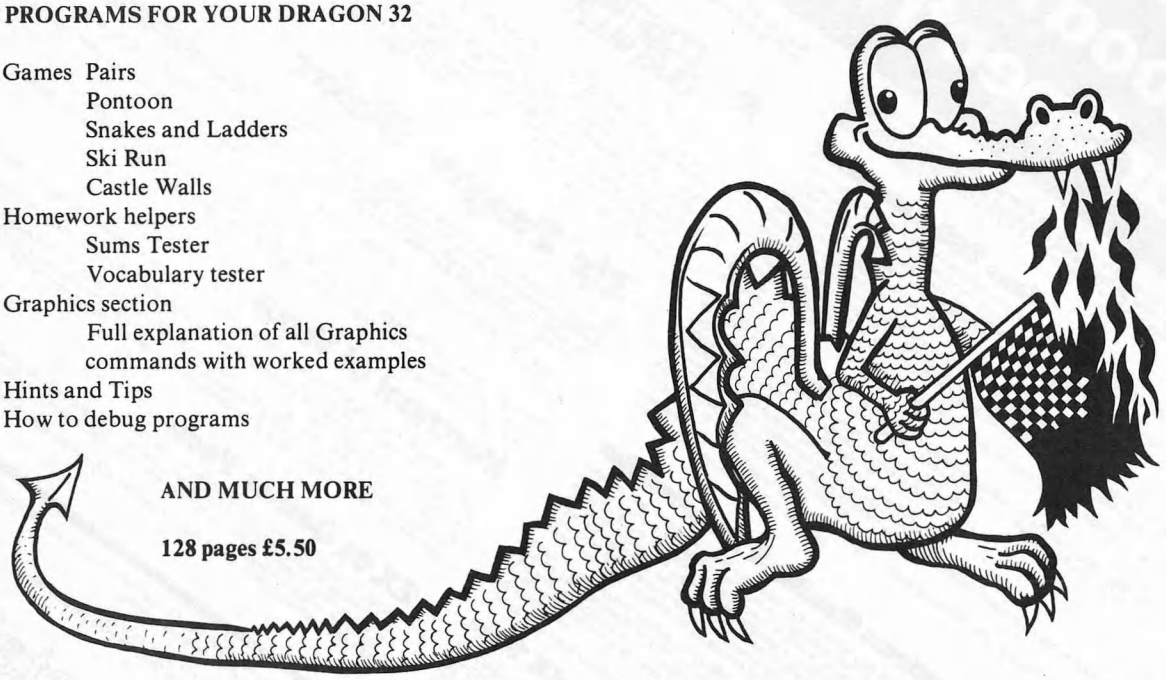

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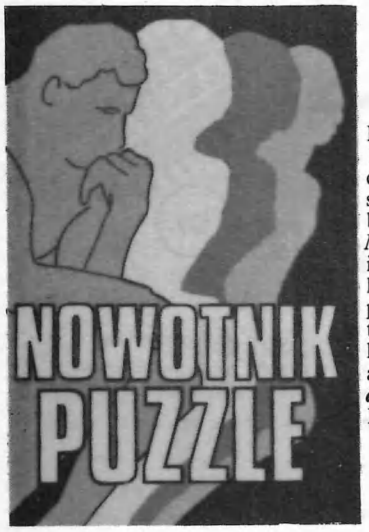

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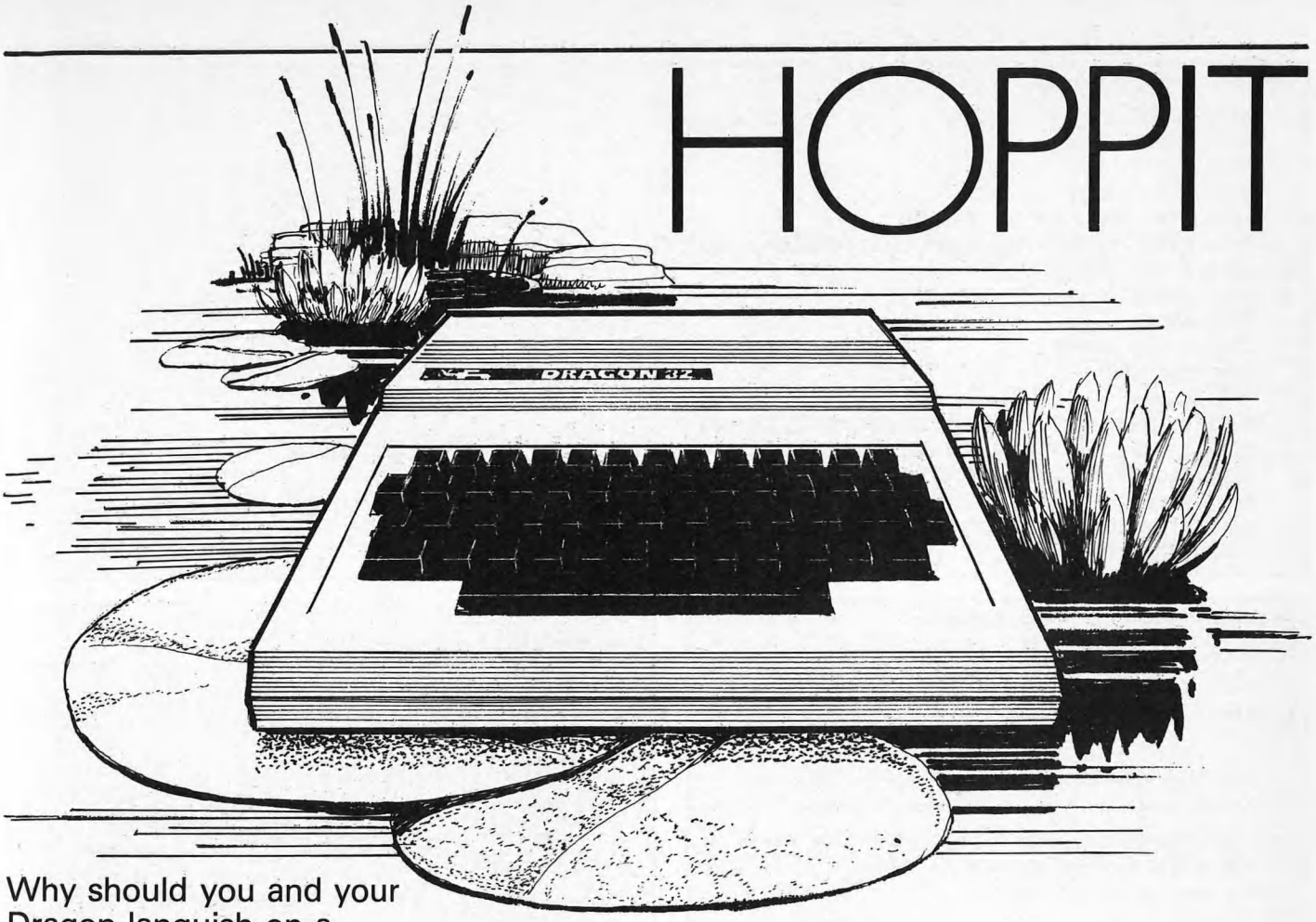

Why should you and your Dragon languish on a lilypad while all the other micros are having fun? Hoppit with Tony Eccles and his troupe of machine-code frogs.

Listing 3. The main program.

```
10 POKE65315,63
20 EXEC 2048
30 PRINT@299,"          ";
40 PRINT@331," HOPPIT ";
50 PRINT@363,"          ";
60 FORF=1 TO 1000:NEXT
70 HS=0:S=0
80 F=3:SC=0
90 X=1040:R=191:BO=5000
100 EXEC 2048
110 PRINT@487,SC;
120 POKEX,R
130 EXEC 2400:BO=BO-10
140 IF PEEK(343)=223 THEN X=X-1
150 IF PEEK(344)=223 THEN X=X+1
160 IF INKEY$=CHR$(10) THEN X=X+64
170 R=PEEK(X)
180 IF X>=1280 AND X<=1312 THEN  X=X+1
190 IF X>=1344 AND X<=1375 THEN X=X-1
200 IF X>=1408 AND X<=1439 THEN X=X+2:R=PEEK(X)
210 IF X>=1216 AND X<=1247 THEN IF RND(10)<5 THEN X=X-1 ELSE X=X+1
215 EXEC 2500
220 POKE X,23
230 IF ((X>=1088 AND X<=1119) OR (X>=1152 AND X<=1183)) AND R<>96 THEN 300
240 REM ****WATERY DEATH****
250 IF R=175 THEN 300
260 REM ****GOT HOME    ****
270 IF R=159 THEN 360
280 GOTO 120
290 REM ***ups a daisy  ***
300 FORPL=1 TO 10:EXEC 2500:NEXT:EXEC 2550:GOSUB 410
310 F=F-1:POKE2046,F+112
320 IF F=0 THEN POKE 2046,115:GOTO 570
330 FOR I=1 TO 1000:NEXT
340 GOTO 90
350 REM ****home at last***
360 PLAY"T23L8ABGFEDBL2BGDCL3BD"
370 S=S+1:POKE65315,63
380 SC=SC+BO
390 GOTO 90
400 REM send out the ambulance
410 PRINT@X-1024,"";
420 P=X-POS(0)+32
430 U=PEEK(X+32)
440 FOR O=P+1 TO X+32
450 POKEO,207:POKEO+1,207:POKEO+2,207
```

(continued on next page)

THIS GAME uses both machine code and Basic, but leaves a lot of memory for those who wish to better my program. The idea of the game is to cross first a road, then a river and reach your friends on the other side. You have to avoid getting run over or drowned.

The machine-code sections are as follows:

2048	Draws the screen which can be almost of your choosing. The screen is moved down from the first 512 bytes of high-res screen. A screen is included along with the program.
2400	Moves the cars, boats and logs.
2100-2400	The routines to move the cars, boats and logs.
2500-2650	Make the sound.

Listing 1 is a good program to enter the machine code and listing 2 can be used to enter the screen then save it along with the machine code. Listing 3 is the program that runs the game. It is advisable to CSavem the machine code after entering it.

Listing 1.

```
10 DATA ********M/C LINE*****
20 CLS:INPUT"ENTER START.";S
30 FORF=S TO 65535
40 READA$:POKEF,VAL("&H"+A$):NEXT
50 REM *****THE PROGRAM WILL STOP
   WITH AN ?OD ERROR*****
```

To draw your own screen you may have to change the Peeks in listing 3. As extras to the game an ambulance arrives if you are killed. There is a bonus which starts off at 5,000, goes down every move and is added on to the score when you reach the shore.

The keys you use to play are the right-arrow, left-arrow and down-arrow.

(continued from previous page)

```
460 EXEC 2600
470 POKE O,U
480 NEXT
490 POKE X,R
500 FOR O=X+32 TO P+29
510 POKE O,207:POKEO+1,23:POKEO+2,207
520 EXEC 2600
530 POKE O,U
540 NEXT
550 EXEC 2048
560 RETURN
570 CLS4
580 PRINT"YOU SCORED"SC"ON"S"SCREENS"
590 IF SC>HS THEN HS=SC:PRINT:PRINT"YOU EVEN GOT THE HIGH SCORE"
600 PRINT:PRINT"HIGH SCORE ="HS
610 PRINT:PRINT:PRINT"PRESS BREAK TO END":PRINT"PRESS ANY OTHER KEY TO PLAY"
620 IF PEEK(337)=255 THEN 620
630 GOTO 80
```

Data for the machine-code parts of Hoppit.

```
2048.....
8E,6,0,10,8E,4,0,A6,80,A7,A0,8C,8,0,26,F7,39
2400.....
BD,8,34,BD,8,66,BD,8,98,BD,8,CA,BD,8,FC,39
2100.....
8E,4,40,10,8E,4,41,A6,84,34,2,A6,A0,A7,80,8C,4,5F,26,F7,35,2,B7,4,5F,39
2150.....
8E,4,80,10,8E,4,81,A6,84,34,2,A6,A0,A7,80,8C,4,9F,26,F7,35,2,B7,4,9F,39
2200.....
8E,5,20,10,8E,5,1F,B6,5,1F,34,2,A6,A2,A7,82,8C,5,0,26,F7,35,2,B7,5,0,39
2250.....
8E,5,40,10,8E,5,41,B6,5,40,34,2,A6,A0,A7,80,8C,5,5F,26,F7,35,2,B7,5,5F,39
2300.....
8E,5,A0,10,8E,5,9F,B6,5,9F,34,2,A6,A2,A7,82,8C,5,80,26,F7,35,2,B7,5,80,39
2500.....
C6,10,96,8C,8B,10,97,8C,BD,BA,D6,BD,BA,D4,5A,26,F1,39
2550.....
C6,3,D7,8E,C6,60,D7,8C,BD,BA,B3,BD,BA,C5,39
2600.....
C6,2,D7,8E,C6,90,D7,8C,BD,BA,B3,BD,BA,C5,C6,2,D7,8E,C6,70,D7,8C,BD,BA,B3,BD,BA,C
5,39
```

Listing 2.

```
1 CLEAR 3000
2 REM ****LISTING 2 ****
10 REM ***SET UP BOTTOM LINE***
20 A$="SCORE                    FROGS  "
30 REM ***SET UP ROAD
40 R$=STRING$(32 ,191)
50 L$=STRING$(32,45)
60 C1$="  [::]    [::]    [::]    [::]  "
70 C2$="    (XX(    (XX(    (XX(    (XX("
80 M$=STRING$(32,138+80)
90 REM***SET UP WATER & BOATS
100 W$=STRING$(32,175)
110 W1$=STRING$(4,175):D$=CHR$(92)
120 B$=CHR$(172)+"x"+STRING$(2,172)+W1$:B$=B$+B$:B$=B$+B$
130 B2$=W1$+"oooo":B2$=B2$+B2$:B2$=B2$+B2$
140 B1$=CHR$(172)+CHR$(168)+STRING$(2,172)+W1$:B1$=B1$+B1$:
    B1$=B1$+B1$
150 Y$=STRING$(32,159)
200 PRINTR$;L$;C1$;L$;C2$;L$;M$;W$;B$;W$;B2$;W$;B1$;W$;Y$;A$;
210 FORF=1024 TO 1535
220 POKE F+512,PEEK(F)
230 NEXT
```


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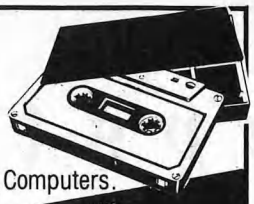

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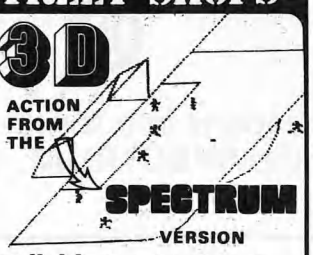

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SINCLAIR USER FEBRUARY 1983

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PRICES: SPECTRUM : PASCAL 4T - £25 inclusive. DEVPAC - £12-50 inclusive.
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BBC

Should you decide to accept your five-year mission, John Wilson's BBC program will have you in a state of readiness long before you get off the interplanetary shuttle.

```
 10 MODE7
 20 PRINTTAB(5,10);"Please wait a few seconds."
 30 ENVELOPE 1,7,2,1,1,1,1,1,121,-10,-5,-2,120,120
 40 X1=10:Y1=10
 50 A=RND(-TIME)
 60 ON ERROR GOTO 3690
 70SC=0:EN=6000:PH=5:CO=1:SH=4000
 80XQ=0:YQ=0:ZQ=0
 90 GOSUB 2590
100 CLS
110VDU 23;8202;0;0;0;
120TIME=0
130VDU 26
140PROCSCREEN
150 *FX4 0
160 VDU 26
170PRINT TAB(30,1);"?          ";TAB(30,1);
180B$=""
190A$=GET$
200PRINT A$;
210 IF A$=CHR$127 THEN B$=LEFT$(B$,LEN B$-1):GOTO 190
220IF A$=CHR$(13) THEN 250
230B$=B$+A$:GOTO 190
240DATA DAMAGE,ALERT,REPAIR,WARP,IMPULSE,PHASER,PHOTON,SCIENCE,SHIP,LONG
250RESTORE 240
260I=1
270READ A$:IF B$=LEFT$(A$,LEN(B$)) THEN 300
280I=I+1:IF I<>11 THEN 270
290GOTO 130
300VDU 28,22,17,38,3
310 IF D%(I)>0 THEN FOR II=0 TO 1000:NEXT:CLS:PROCDAM(I):GOTO 130
320ON I GOTO 330,400,500,600,1990,1440,1700,950,730,1130
330CLS
340PRINT "DAMAGE CONTOL"
350PRINT "______________"
360I=2:REPEAT
370IF D%(I)>0 THEN PROCDAM(I)
380I=I+1:UNTIL I=11
390GOTO 130
400CLS
410PRINT "ALERT CONTROL"
420PRINT "______________"
430PRINT '"1=GREEN"
440 IF SH>500 THEN PRINT "2=YELLOW"
450IF SH>1500 THEN PRINT "3=RED"
460CO=GET-48:IF CO<1 OR CO>3 THEN 460
470IF SH<500 THEN CO=1
480IF SH<1500 AND CO=3 THEN CO=2
490GOTO 130
500CLS
510PRINT "REPAIR CONTROL"
520PRINT "______________"
530PRINT "THE DAMAGE IS NOW"
540I=1:REPEAT
550D%(I)=D%(I)-RND(5):IF D%(I)<0 THEN D%(I)=0
560IF D%(I)>0 THEN PROCDAM(I)
570I=I+1:UNTIL I=11
580TIME=TIME+RND(20)*1000:EN=EN-100
590GOTO 130
600CLS
610PRINT "WARP DRIVE"
620PRINT "__________"
630PRINT "TO WHAT QUADRANT X,Y,Z ?"
640INPUT X,Y,Z
650IF X<0 OR X>7 OR Y<0 OR Y>7 OR Z<0 OR Z>7 THEN 600
660PRINT "WHAT SPEED (1 TO 9)"
670A=GET-48:IF A<1 OR A>9 THEN 670
680D=(ABS(X-XQ)+ABS(Y-YQ)+ABS(Z-ZQ))
690EN=EN-D*A
700ZQ=INT(Z):YQ=INT(Y):XQ=INT(X)
710TIME=TIME+1000*D/A
720GOTO 130
730CLS
740PRINT "SHIPS COMPUTER"
750PRINT "______________"
760PRINT "A DATA BASE SCAN FOR WHAT ?"
770PRINT "1=STARBASE"
780PRINT "2=KLINGON"
790PRINT "3=BLACK HOLE"
800PRINT "4=M CLASS PLANET"
810PRINT "5=G CLASS PLANET"
820PRINT "6=STARFLEET HQ"
830A=GET-48:IF A<1 OR A>6 THEN 830
840IF A=3 THEN 930
850IF A=6 THEN PRINT "STARFLEET HQ      IS AT ";XHQ;YHQ;ZHQ:GOTO 130
860 W=6:IF A=4 THEN W=10
870 IF A=5 THEN W=9
880 IF A=2 THEN W=-1
890 FOR Z=0 TO 7:FOR Y=0 TO 7:FOR X=0 TO 7
900 G=?(Z%+X+Y*8+Z*64)
910 IF G=W OR (G>20 AND G<41 AND A=2) THEN PRINT "AT";X;Y;Z
920 NEXT X,Y,Z:GOTO 130
930 IF ?(Z%+XBL+YBL*8+ZBL*64)=17 THEN 130
940 PRINT "BLACK HOLE AT";XBL;YBL;ZBL:GOTO 130
950 CLS
960 PRINT "SCIENCE COMPUTER"
970 PRINT "________________"
980 Q=?(Z%+XQ+YQ*8+ZQ*64)
990 PRINT "COMPUTER INDICATE"
1000 IF Q=7 OR Q=17 THEN PRINT "A BLACK HOLE":GOTO 130
1010 IF Q=6 OR Q=16 THEN PRINT "A STARBASE":GOTO 130
1020 IF Q=10 THEN PRINT "AN EXPLORED M    CLASS PLANET":GOTO 130
1030 IF Q=9 THEN PRINT "AN EXPLORED G    CLASS PLANET":GOTO 130
1040 IF Q=20 THEN PRINT "AN M CLASS PLANET"
1050 IF Q=19 THEN PRINT "A G CLASS PLANET"
```

UNLIKE MANY games, this has an ultimate goal and end. You do not keep on fighting until you die. Your five-year mission is to boldly go where no man has gone before, seeking out new forms of life and persuading them of the immense economic advantages that would accrue from Federation membership. Klingons sadly can never see your point of view but that is what your phaser banks are for. The mission can be finished within an hour; the player must think up his own tactics, and try them. As the galaxy is randomly set up, the game will never be the same twice.

I do not intend to go into a lengthy description of how the program works. It only uses a few special instructions for the BBC Micro, so it can readily be modified for other computers. The only problem I can foresee with converting it, is getting the graphics right. These reside between lines 1210 to 1340 and 1950 to 3180. As the program is so big, I had to use Teletext mode for the graphics, and store the galaxy array as memory locations. This array holds all the information about the galaxy, including the positions and strengths

```
1060 IF Q>40 THEN PRINT "A KLINGON WARSHIP!":?(Z%+XQ+YQ*8+ZQ*64)=Q-20:GOTO 130
1070 IF Q>20 THEN PRINT "A KLINGON WARSHIP!":GOTO 130
1080 IF Q=0 THEN PRINT "VOID":GOTO 130
1090 ?(Z%+XQ+YQ*8+ZQ*64)=Q-10
1100 SC=SC+25:IF Q=20 THEN SC=SC+25:MP=MP-1 ELSE GP=GP-1
1110 PROCPLANET
1120 GOTO 130
1130 CLS
1140 PRINT "LONG RANGE SCAN"
1150 PRINT "______________"
1160 VDU 28,1,19,20,1
1170 CLS
1180 M=3:N=2
1190 PRINT "     ";XQ-1;"     ";XQ;"     ";XQ+1
1200 FOR Y=YQ-1 TO YQ+1
1210 PRINT TAB(0,N+1);Y;
1220 FOR X=XQ-1 TO XQ+1
1230 IF X<0 OR X>7 OR Y<0 OR Y>7 THEN B1$="     ":B2$="     ":B3$="     ":GOTO 135
0
1240 B1$=CHR$146+CHR$32+CHR$248+CHR$228+CHR$32
1250 B2$=CHR$146+CHR$42+CHR$253+CHR$244+CHR$165
1260 B3$=CHR$146+CHR$32+CHR$162+CHR$161+CHR$32
1270 Q=?(Z%+X+Y*8+ZQ*64)
1280 IF Q=0 THEN B1$=CHR$148+"0000":B2$=CHR$148+"0000":B3$=CHR$148+"0000"
1290 IF Q>10 AND Q<19 THEN Q=Q-10
1300 IF Q>40 THEN Q=Q-20
1310 ?(Z%+X+Y*8+ZQ*64)=Q
1320 IF Q=7 THEN B1$=CHR$151+CHR$184+CHR$185+CHR$115+CHR$36:B2$=CHR$151+CHR$106
+CHR$42+CHR$36+CHR$119:B3$=CHR$151+CHR$41+CHR$185+CHR$172+CHR$185
1330 IF Q=6 THEN B1$=CHR$145+CHR$224+CHR$32+CHR$32+CHR$32:B2$=CHR$145+CHR$106+C
HR$248+CHR$117+CHR$52:B3$=CHR$149+CHR$171+CHR$255+CHR$255+CHR$39
1340 IF Q>20 THEN B1$=CHR$150+CHR$32+CHR$180+CHR$32+CHR$180:B2$=CHR$150+CHR$32+
CHR$170+CHR$190+CHR$32:B3$=CHR$150+CHR$32+CHR$170+CHR$175+CHR$32
1350 PRINT TAB(M,N);B1$;CHR$135;
1360 PRINT TAB(M,N+1);B2$;CHR$135;
1370 PRINT TAB(M,N+2);B3$;CHR$135;
1380 M=M+5
1390 NEXT X
1400 M=3:N=N+4
1410 NEXT Y
1420 VDU 28,22,17,38,3
1430 GOTO 130
1440 CLS
1450 PRINT "PHASER BANK"
```

(continued on page 97)

of Klingons, Starbases and different types of planets.

The galaxy is a three-dimensional eight by eight by eight galaxy, with each level number 0 to 7, each column 0 to 7 and each row 0 to 7. Placed randomly in the galaxy is a random number of M-class planets and a random number of G-class planets. As well as these, there is a Black Hole and Starfleet HQ.

The commands available to the player are as follows:

Command	Shortened version
Damage control	return
Alert control	A
Repair control	R
Warp drive	W
Impulse engines	I
Phaser control	PHA
Photon torpedo control	PHO
Science computer	SC
Ship's computer	SH
Long-range scanner	L

From the listing, you can see that every command announces itself, so it should be quite easy to modify or add new commands.

Damage control, if not damaged itself, describes the damage sustained by each part of the ship. The higher the number, the more damage sustained. The command can only be used if it has sustained no damage, that is, if it does not appear in the list.

Alert control can be used to change the condition of your shields, that is, full-on, or off. Red is full-on, yellow is half-on, and green is off. As your shields are damaged, you cannot use the shields full on. Unfortunately, the shields drain a lot of energy, so it is not a good idea to stay in condition Red.

Repair control can be used to repair damage at a higher rate than normal. Repairs are automatically done when your ship is damaged anyway, but for fast repairs this command is used.

The warp drive can be used to move to any sector in the galaxy. After typing this command, the player must enter the destination co-ordinates x,y,z and the speed. The higher the speed, the faster you get there, but the more energy you use up.

Impulse engines are used to dock with a Starbase or HQ. On entering a sector containing a Starbase and using this command, the player must try to dock the Starship with the Starbase. This is done by moving left or right with the cursor keys, as it moves towards the Starbase. On docking, your energy is replenished, you get back your photon torpedoes, and some of your damage is repaired. The Starbase then disappears. Note, if you land at HQ — it looks like a Starbase — the game will automatically end.

The science computer is used to scan a planet and log information about it. Every planet must be scanned in this way to finish the game. Only your sector is scanned at one time.

The ship's computer is used as a database holding all the information that you have scanned on your journey through the galaxy. It is used to search for any Klingons on planets that you have scanned. Therefore, if you find a Klingon, its position will be stored in the ship's computer ready for use.

The long-range scanner is used to give a visual description of the sectors adjacent to you. Any information found will be stored in the ship's computer.

The phaser banks can be used to fire on a Klingon in your sector. They will always hit, but do not necessarily destroy the Klingon. It puts up an energy screen, too. The phaser banks drain a lot of energy, so do not use them too much.

The photon torpedo is the ultimate weapon. It will destroy the Klingon immediately if you hit it. The problem is that it must be aimed. To destroy a Klingon, you must hit him in the centre. Also, you only get five, so do not waste them.

If you enter a sector containing a Klingon, he will shoot at you, so be prepared. Put your screens up and go into combat with little damage, plenty of energy and at least one photon torpedo.

To make the game even harder, I have included a Black Hole somewhere in the galaxy. If you get close to it, you will get sucked towards it. Also, if you enter the same sector, you would be totally destroyed by a Black Hole. Therefore, avoid the Black Hole if possible.

The various galactic features may be distinguished as follows: planets are green, the void is blue, the Black Hole is ironically white, Starbases are red and magenta, and Klingons are cyan; they turn white and re-configure for combat. If you finally complete the game, the computer will tell you your final score and will comment on it. Starfleet expects every sentient life-form to do its duty.

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(continued from page 95)

```
1460 PRINT "____________"
1470 PRINT "PHASERS READY ANDWAITING."
1480 Q=?(Z%+XQ+YQ*8+ZQ*64):IF Q<21 THEN PRINT "BUT WHAT ARE YOU FIRING AT ?":GO
TO 130
1490 PRINT "PRESS SPACE TO   FIRE"
1500 REPEAT UNTIL GET$=" "
1510 CLS
1520 VDU 28,1,19,20,1
1530 X1=5:Y1=9
1540 PROCK
1550 FOR Y=17 TO 12 STEP -1
1560 PRINT TAB(18-Y,Y);CHR$151;CHR$50;CHR$135;
1570 SOUND 1,17,Y*3,2
1580 PRINT TAB(Y,Y);CHR$151;CHR$97;CHR$135;
1590 FOR I=0 TO 500:NEXT
1600 NEXT Y
1610 EN=EN-50
1620 CLS
1630 V=?(Z%+XQ+YQ*8+ZQ*64):B=V-RND(5)-3
1640 IF B>21 OR (B>41 AND V>40) THEN ?(Z%+XQ+YQ*8+ZQ*64)=B:GOTO 130
1650 PROCEXPLOSION
1660 SC=SC+RND(50)+20
1670 ?(Z%+XQ+YQ*8+ZQ*64)=0
1680 KL=KL-1
1690 GOTO 130
1700 CLS
1710 PRINT "PHOTON TORPEDOE"
1720 PRINT "_______________"
1730 IF PH=0 THEN PRINT "YOU AINT GOT NONELEFT!":GOTO 130
1740 Q=?(Z%+XQ+YQ*8+ZQ*64):IF Q<21 THEN PRINT "WHAT ARE YOU     FIRING AT ?":GO
TO 130
1750 PRINT '"Press 'SPACE' to fire torpedoe."
1760 PRINT ''"Press 'SPACE' to start sweep of   sights."
1770 REPEAT UNTIL GET$=" "
1780 CLS
1790 VDU 28,1,19,20,1
1800 X1=RND(6):Y1=RND(10)
1810 X=0:Y=0
1820 PROCK
1830 PRINT TAB(X,Y);"X";
1840 X=X+1:IF X=20 THEN X=0:Y=Y+1
1850 IF Y=20 THEN Y=0
1860 IF INKEY$(0)=" " THEN 1880
1870 GOTO 1820
1880 PH=PH-1
1890 FOR I=0 TO 20
1900 SOUND 2,17+I/3,(20-I)*3,1
1910 NEXT
1920 IF X<X1+5 OR X>X1+8 OR Y<>Y1+1 THEN 130
1930 PROCEXPLOSION
1940 SC=SC+RND(50)+20
1950 ?(Z%+XQ+YQ*8+ZQ*64)=0
1960 KL=KL-1
1970 CLS
1980 GOTO 130
1990 CLS
2000 PRINT "IMPULSE ENGINES"
2010 PRINT "_______________"
2020 Q=?(Z%+XQ+YQ*8+ZQ*64)
2030 IF Q=10 OR Q=9 THEN PRINT "ORBIT SUSTAINED":SC=SC+RND(10):GOTO 130
2040 IF Q<>6 AND Q<>16 THEN PRINT "THERE IS NOTHING TO ORBIT":GOTO 130
2050 PRINT "PREPARE FOR      DOCKING PROCEDURE"
2060 PRINT "USE THE CURSOR   CONTROL KEYS TO  MOVE YOUR SHUTTLE"
2070 PRINT "Press 'SPACE' to start."
2080 REPEAT UNTIL GET$=" "
2090 XS=RND(10)+5:YS=0
2100 VDU 28,1,19,20,1
2110 *FX 4,1
2120 X1=RND(10)+5:Y1=RND(10)+5
2130 CLS
2140 PRINT TAB(X1,Y1);"O";TAB(XS,YS);"A";
2150 A$=INKEY$(20):IF A$=CHR$(&88) THEN XS=XS-1
2160 IF A$=CHR$(&89) THEN XS=XS+1
2170 YS=YS+1
2180 IF YS=18 THEN 130
2190 IF XS<0 THEN XS=0
2200 IF XS>19 THEN XS=19
2210 IF XS=X1 AND YS=Y1 THEN 2230
2220 EN=EN-1:GOTO 2130
2230 VDU 28,22,17,38,3
2240 CLS
2250 PRINT "DOCKED."
2260 EN=6000:PH=5:?(Z%+XQ+YQ*8+ZQ*64)=0
2270 SOUND 1,17,100,4
2280 IF XQ=XHQ AND YQ=YHQ AND ZQ=ZHQ THEN 3500
2290 I=1
2300 D=RND(10)
2310 D%(D)=D%(D)-5:IF D%(D)<0 THEN D%(D)=0
2320 I=I+1:IF I<6 THEN GOTO 2300
2330 SH=SH+RND(500):IF SH>4000 THEN SH=4000
2340 GOTO 130
2350 DEFPROCSCREEN
2360 LOCAL I,B$
2370 PRINT STRING$(40,"*");
2380 PRINT TAB(21,2);STRING$(19,"*");
2390 PRINT TAB(0,23);STRING$(40,"*");
2400 PRINT TAB(0,20);STRING$(22,"*");
2410 PRINT TAB(22,18);STRING$(18,"*");
2420 FOR I=0 TO 23:PRINT TAB(0,I);"*";TAB(39,I);"*";
2430 IF I<=20 THEN PRINT TAB(21,I);"*";
2440 NEXT I
2450 PRINT TAB(1,21);"SCORE=";SC;TAB(13,21);"ENERGY=";EN;" ";TAB(26,21);"TORPED
OES=";PH;
2460 PRINT TAB(1,22);"SHIELD=";SH;" QUADRANT=";XQ;YQ;ZQ;" KL=";KL;" PL=";MP+GP;
" ";
2470 B$=CHR$(130)+"GREEN"+CHR$(135):IF CO=2 THEN B$=CHR$(131)+"YELLOW"
2480 IF CO=3 THEN B$=CHR$(136)+CHR$(129)+"RED"+CHR$(135)
2490 PRINT TAB(22,19);"CONDITION=";B$;
2500 PRINT TAB(22,20);"STARDATE=";INT(TIME/1000);
2510 PRINT TAB(22,1);"COMMAND=";
2520 IF ?(Z%+XQ+YQ*8+ZQ*64)>20 THEN PROCKLINGON
2530 D=RND(10):D%(D)=D%(D)-RND(5):IF D%(D)<0 THEN D%(D)=0
2540 EN=EN-1-CO*50+50:IF EN<0 THEN 3480
2550 d=ABS(XQ-XBL)+ABS(YQ-YBL)+ABS(ZQ-ZBL)
2560 IF RND(d*5)=1 THEN PROCSUCK
2570 IF XQ=XBL AND YQ=YBL AND ZQ=ZBL THEN 3490
2580 ENDPROC
2590 DIM Z% 512,D%(10)
2600 FOR I=0 TO 512:Z%?I=0:NEXT
2610 KL=20+RND(10):GP=RND(10)+5:MP=RND(10)+5
2620 FOR I=1 TO KL:PROCRND:?(Z%+X+Y*8+Z*64)=40+RND(20):NEXT
2630 FOR I=1 TO MP:PROCRND:?(Z%+X+Y*8+Z*64)=20:NEXT
2640 FOR I=1 TO GP:PROCRND:?(Z%+X+Y*8+Z*64)=19:NEXT
2650 FOR I=1 TO RND(5)+2:PROCRND:?(Z%+X+Y*8+Z*64)=16:NEXT
2660 XHQ=X:YHQ=Y:ZHQ=Z
2670 PROCRND:?(Z%+X+Y*8+Z*64)=17:XBL=X:YBL=Y:ZBL=Z
2680 RETURN
2690 DEFPROCRND
2700 X=RND(8)-1:Y=RND(8)-1:Z=RND(8)-1
2710 IF ?(Z%+X+Y*8+Z*64)<>0 THEN 2700
2720 ENDPROC
2730 DEFPROCDAM(D)
2740 LOCAL I,B$
2750 RESTORE 2760
2760 DATA DAMAGE CONTROL,ALERT,REPAIR,WARP DRIVE,IMPULSE ENGINES,PHASER BANK,PH
OTON TORP.,SCIENCE COMP.,SHIP COMP.,LONG SCAN
2770 FOR I=1 TO D:READ B$:NEXT
2780 PRINT B$;"=";D%(D)
2790 ENDPROC
2800 DEFPROCPLANET
2810 LOCAL H,S,A,W,T,B$,I
2820 H=RND(20)-1:S=(RND(20)-.5)*100:A=RND(5):W=RND(100):T=RND(18)
2830 PRINT "LIFE=";H;" BILLION"
2840 PRINT "RADIUS=";S;" K"
2850 RESTORE 2860
2860 DATA CORROSIVE,DENSE,NORMAL,THIN,NONE
2870 FOR I=1 TO A:READ B$:NEXT I
2880 PRINT "ATMOSPHERE:"'B$
2890 PRINT ;W;"% WATER"
2900 PRINT "TECH LEVEL=";T
2910 SC=SC+T-8+H-10
2920 ENDPROC
2930 DEFPROCEXPLOSION
2940 PRINT TAB(X1+4,Y1+2);CHR$145;CHR$255;CHR$255;CHR$135
2950 SOUND 0,1,1,10
2960 SOUND 0,1,2,10
2970 SOUND 0,1,3,10
2980 FOR I=0 TO 1000:NEXT
2990 PRINT TAB(X1+3,Y1);
3000 VDU 150,114,170,36,58,135
3010 PRINT TAB(X1+3,Y1+1);
3020 VDU 150,164,110,189,168,135
3030 PRINT TAB(X1+3,Y1+2);
3040 VDU 150,50,184,52,57,135
3050 FOR I=0 TO 1000:NEXT
3060 PRINT TAB(X1+1,Y1);:VDU 147,33,36,49,96,40,135
3070 PRINT TAB(X1+1,Y1+1);:VDU 147,33,225,241,50,168,135
3080 PRINT TAB(X1+1,Y1+2);:VDU 147,96,250,55,36,49,135
3090 PRINT TAB(X1+1,Y1+3);:VDU 147,50,166,36,225,180,135
3100 FOR I=0 TO 1000:NEXT
3110 CLS
3120 ENDPROC
3130 DEFPROCKLINGON
3140 Q=?(Z%+XQ+YQ*8+ZQ*64)
3150 IF Q<41 THEN W=(Q-20)*5 ELSE W=(Q-40)*5
3160 VDU 28,1,19,20,1
3170 X1=5:Y1=0
3180 PROCK
3190 FOR Y1=4 TO 18 STEP 2
3200 PRINT TAB(9,Y1);
3210 VDU 147,53,135
3220 SOUND 3,1,(20-Y1)*3,2
3230 FOR X1=0 TO 200:NEXT
3240 NEXT Y1
3250 VDU 28,22,17,38,3
3260 CLS
3270 IF RND(5)<3 THEN ENDPROC
3280 IF SH<0 THEN 3430
3290 IF W>RND(50*CO) THEN 3350
3300 PRINT "YOU HAVE SUFFEREDA MINOR HIT"
3310 SH=SH-RND(50)
3320 IF SH<0 THEN 3430
3330 D=RND(10):D%(D)=D%(D)+1
3340 ENDPROC
3350 PRINT "YOU HAVE SUFFEREDA MAJOR HIT"
3360 SH=SH-RND(300)
3370 LOCAL I
3380 I=1
3390 D=RND(10)
3400 D%(D)=D%(D)+RND(3)
3410 I=I+1:IF I<6 THEN 3390
3420 ENDPROC
3430 B$="whilst doing battle against the Klingons"
3440 VDU 26:CLS
3450 PRINT'':M$="   On Stardate "+STR$INT(TIME/1000)+", "+B$+", the Enterprise
& crew were lost to space."
3460 PROCMES(M$)
3470 GOTO 3640
3480 B$="after depleting its energy supply":GOTO 3440
3490 B$="after flying into a Black Hole":GOTO3440
3500 VDU 26:CLS
3510 M$="   Admiral Fitzpatrick here... Captain, after studying your log and da
ta tapes, and taking into account that you were "
3520 IF TIME<1000000 THEN M$=M$+"on time":SC=SC*1.5 ELSE M$=M$+"late":SC=SC/1.5
3530 M$=M$+" and that you "
3540 IF KL=0 AND MP=0 AND GP=0 THEN M$=M$+"completed":SC=SC*2 ELSE M$=M$+"faile
d":SC=SC/2
3550 M$=M$+" your mission."
3560 PROCMES(M$)
3570 PRINT''
3580 M$="I am going to recommend to Starfleet that you be "
3590 RESTORE 3600
3600 DATA PROMOTED,2000,DECORATED,1500,REASIGNED,1000,DEMOTED,500,RESIGNED,250,
EXECUTED,-1
3610 READ B$,S:IF SC<S THEN 3610
3620 M$=M$+B$+" after getting a total score of "+STR$INTSC
3630 PROCMES(M$)
3640 PRINT''
3650 PRINT"Another game (y/n) ?"
3660 A$=GET$:IF A$="Y" THEN RUN
3670 IF A$="N" THEN END
3680 GOTO 3660
3690 IF ERR=17 THEN GOTO 130
3700 CLS
3710 PRINT'''
3720 REPORT
3730 PRINT " in line ";ERL
3740 END
3750 DEFPROCSUCK
3760 XQ=XQ-(XQ<XBL)+(XQ>XBL)
3770 YQ=YQ-(YQ<YBL)+(YQ>YBL)
3780 ZQ=ZQ-(ZQ<ZBL)+(ZQ>ZBL)
3790VDU 28,22,17,38,3
3800 FOR II=0 TO 1000:NEXT:CLS
3810 PRINT"WARNING:"
3820 PRINT"________"
3830 PRINT"  The Enterprise is being drawn"'"through space"'"towards a Black"'"
hole."
3840 ENDPROC
3850 DEFPROCK
3860 CLS
3870 PRINT TAB(X1,Y1);
3880 VDU 151,163,41,48,32,53,32,56,163,33,135
3890 PRINT TAB(X1+2,Y1+1);
3900 VDU 151,234,243,119,251,135
3910 PRINT TAB(X1+1,Y1+2);
3920 VDU 151,40,33,34,163,32,41,135
3930 ENDPROC
3940 DEF PROCMES(A$)
3950 LOCAL X%,I%,J%
3960 $&A00="."+A$
3970 X%=0
3980 I%=1
3990 J%=&A00
4000 IF J%?I%=32 OR J%?I%=13 THEN 4020
4010 I%=I%+1:GOTO 4000
4020 IF X%+I%>39 THEN PRINT:X%=0
4030 FOR U%=1 TO I%
4040 VDU J%?U%
4050 NEXT
4060 J%=J%+I%
4070 X%=X%+I%
4080 I%=1
4090 IF J%-&A00>=LENA$ THEN ENDPROC
4100 GOTO 4000
```

VIC-20

Watch out there's a barrel about in Martin Lightfoot's light-hearted Vic-20 game.

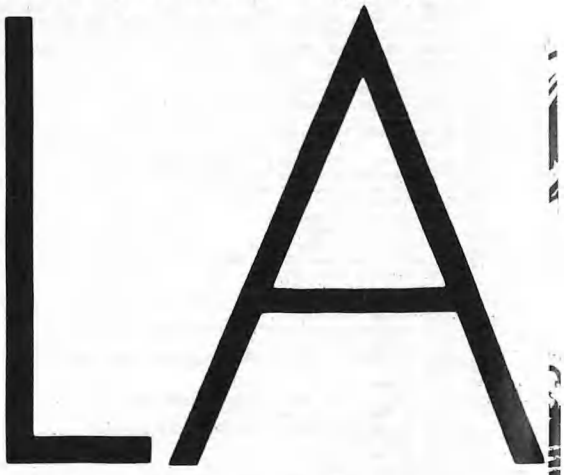
```
 0 FORB=1TO8:HS(B)=500:HS$(B)="----------":NEXTB:GOTO9500
 1 CC=AD+X+NO*Y:DD=CA+CC:POKECC,XX:POKEDD,CO:SYSMC:IFPEEK(CC)=0THEN1000
 2 POKECC,16:POKEDD,1:RETURN
 5 SL=.6:SE=50:AM=3:SC=0
 10 POKE36879,11:PRINT"■":POKE36869,207
 12 FORQ=0TO21:POKE37976+Q,5:POKE38064+Q,5:POKE38152+Q,5:POKE38240+Q,5:POKE38328
+Q,5:NEXT
 20 FORH=4118TO4601STEP88:FORG=0TO21:POKEH+G,1:NEXTG,H
 33 FORS=1TO4
 34 POKE4189+S*22,8:POKE4189+33792+S*22,3:POKE4287+S*22,8:POKE33792+4287+S*22,3
 35 POKE4368+S*22,8:POKE4368+33792+S*22,3:POKE4460+S*22,8:POKE33792+4460+S*22,3
 36 NEXTS
 40 A$="BC■■DE■■FG":B$="IJ■■KL■■MN"
 50 PRINT"■■■A$"■■■TAB(20)B$"■■A$"■■TAB(20)B$"■■A$"■"
 60 PRINT"■■SCORE";SC;TAB(12)"HIGH";HS(1)
 65 AD=4096:X=17:Y=20:XX=32:CA=33792:CO=5:NO=22:MC=5000:Y1=0:X1=0:JU=0:ZX=0
 70 FORW=1TO10
 73 V=INT(RND(1)*506)
 75 IFPEEK(AD+V)=32ANDPEEK(AD+V+44)=1THENPOKEAD+V,15:POKECA+AD+V,7:GOTO80
 78 GOTO73
 80 NEXTW
 90 A(1)=4187:A(2)=4363:A(3)=4539:A(4)=4290:A(5)=4466
 100 IFRND(1)>SLTHENPOKEA(INT(RND(1)*5)+1),0
 110 GOSUB1:VV=PEEK(197):UU=PEEK(653)
 115 IFJU=2THENJU=0:Y1=1:GOTO150
 120 IFJU=1THENJU=2:GOTO150
 130 IFUU=1THENJU=1:Y1=-1:GOTO150
 140 Y1=(VV=13ANDXX=8)-(VV=37ANDPEEK(CC+22)=8)
 150 GOSUB1:X1=(VV=21ANDX>0ANDY/4=INT(Y/4))-(VV=22ANDX<21ANDY/4=INT(Y/4))
 160 POKECC,XX:POKEDD,CO:X=X+X1:Y=Y+Y1:Y1=0:X1=0:XX=PEEK(AD+X+NO*Y):CO=PEEK(AD+X
+NO*Y+CA)
 165 IFXX=0THEN1000
 166 IFQW=1THENQW=0:GOTO2000
 167 IFXX=15THENSC=SC+SE:PRINT"■■■■■■■";SC:XX=32:ZX=ZX+1:IFZX=10THENQW=1
 170 GOTO100
 1000 POKEAD+X+NO*Y,17
 1005 POKE36877,220:FORL=15TO0STEP-1:POKE36878,L:FORM=1TO80:NEXTM,L:POKE36877,0:
POKE36878,0
 1010 AM=AM-1:IFAM=0THEN1500
 1020 PRINT"■":POKE36879,25:POKE36869,192
 1030 PRINT"■■■■■■"TAB(8)"MEN";AM
 1040 PRINT"■■"TAB(6)"SCORE";SC
 1050 FORG=1TO2000:NEXTG:GOTO10
 1500 POKE36879,8:POKE36869,192
 1505 FORW=1TO10
 1510 PRINT"■■■■■"TAB(7)"■■GAME OVER■"
 1520 FORH=1TO100:NEXT
 1525 PRINT"■"
 1526 FORH=1TO100:NEXTH,W
 1530 PRINT"■■■"TAB(7)"SCORE";SC
 1535 FORJ=1TO1000:NEXTJ
 1540 IFSC>HS(8)THENHS(8)=SC:GOTO1600
 1550 GOTO1650
 1600 PRINT"■■INPUT YOUR NAME(MAX   10 LETTERS)":POKE198,0
 1601 INPUT"■■";HS$(8)
 1603 IFLEN(HS$(8))>10THEN1600
 1606 C=0
 1608 FORG=1TO7
 1610 IFHS(G)>=HS(G+1)THEN1630
 1620 C=1:X=HS(G):HS(G)=HS(G+1):HS(G+1)=X:X$=HS$(G):HS$(G)=HS$(G+1):HS$(G+1)=X$
 1630 NEXTG
 1640 IFC=1THEN1606
 1650 POKE36879,9
 1700 PRINT"■■■■■HIGH SCORE TABLE":PRINT"   ================"
 1710 FORT=1TO8:PRINT"■■"T;TAB(4)"■"HS$(T)TAB(15)"■"HS(T):NEXTT
 1720 PRINT"■"TAB(6)"■■HIT A KEY■"
 1730 POKE198,0
 1740 GETR$:IFR$=""THEN1740
 1750 GOTO5
 2000 SL=SL-.1:IFSL<0THENSL=0
 2020 SE=SE+50
 2030 POKE36878,15:FORL=1TO5:FORM=180TO235STEP2:POKE36876,M:FORN=1TO5:NEXTN,M
 2035 POKE36876,0:FORM=1TO100:NEXTM,L:POKE36878,0
 2040 GOTO10
 8000 PRINT"■■":POKE36879,25
 8010 PRINT"DATA ERROR IN LINES   10000 ONWARDS":END
 8020 PRINT"■■":POKE36879,25
 8030 PRINT"DATA ERROR IN LINES   9020 TO 9100":END
 9000 IFPEEK(7168)=60ANDPEEK(5166)=96THEN9017
 9001 T=0
 9005 FORT=7424TO7431:POKET,0:NEXT
 9008 S=7168
 9010 READA$:IFA$<>"*"THEN9015
 9011 IFT<>23324THEN8020
 9012 GOTO9016
 9015 POKES,VAL(A$):S=S+1:T=T+VAL(A$):GOTO9010
 9016 FORN=5000TO5166:READM:POKEN,M:TT=TT+M:NEXTN:IFTT<>18797THEN8000
 9017 PRINT"■"TAB(10)"■ ↑ ↑ ↑ ↑":POKE198,0
 9018 GETR$:IFR$=""THEN9018
 9019 GOTO5
 9020 DATA60,102,251,253,253,255,126,60,253,175,251,222,0,0,0,0
 9030 DATA12,18,2,3,55,79,15,31,96,144,128,192,192,160,224,240
 9040 DATA123,159,22,127,157,31,110,139,112,248,216,236,108,228,224,160
 9050 DATA30,39,15,3,3,3,7,7,192,192,128,128,128,128,224,240
 9060 DATA129,129,255,129,129,129,255,129,6,9,1,3,3,5,7,15
 9070 DATA48,72,64,192,236,242,240,248,14,31,27,55,54,39,7,5
 9080 DATA222,249,105,254,185,248,118,209,3,3,1,1,1,1,7,15
 9090 DATA120,228,240,192,192,192,224,224,254,170,214,170,254,0,0,0
 9100 DATA28,28,8,62,93,28,54,99,80,5,144,34,136,2,32,137,*
```

THIS PROGRAM is written for the Vic-20 with at least 8K memory expansion. It comes in two parts, the first being a short program which changes the start of Basic to allow high-resolution graphic characters to be used. The second listing is the actual game. It is important to load and run the first program because otherwise the program will crash.

In program 1, you will have to save it before running it because the last line switches the Vic off and on, and your program will disappear from memory.

In the main program, a machine-code routine is used to scroll the barrels across the screen. This machine code is contained in Data statements, and any errors will probably result in the program crashing. That is why I have used a data check to make sure no mistakes have been made in typing them in. There is also a check in the data for the high-resolution characters, in which any mistakes will be found.

In the game, you are the man at the bottom of the screen. Your task is to go round collecting the blocks above your head. To reach them you have to jump by pressing Shift. But also in the game are five hairy monsters who are determined to get you. They roll barrels at you, which you must avoid by making a run for the nearest ladder or by jumping over them. After you clear a screen of ten blocks, another one appears. The barrels come at an increased rate, making the game



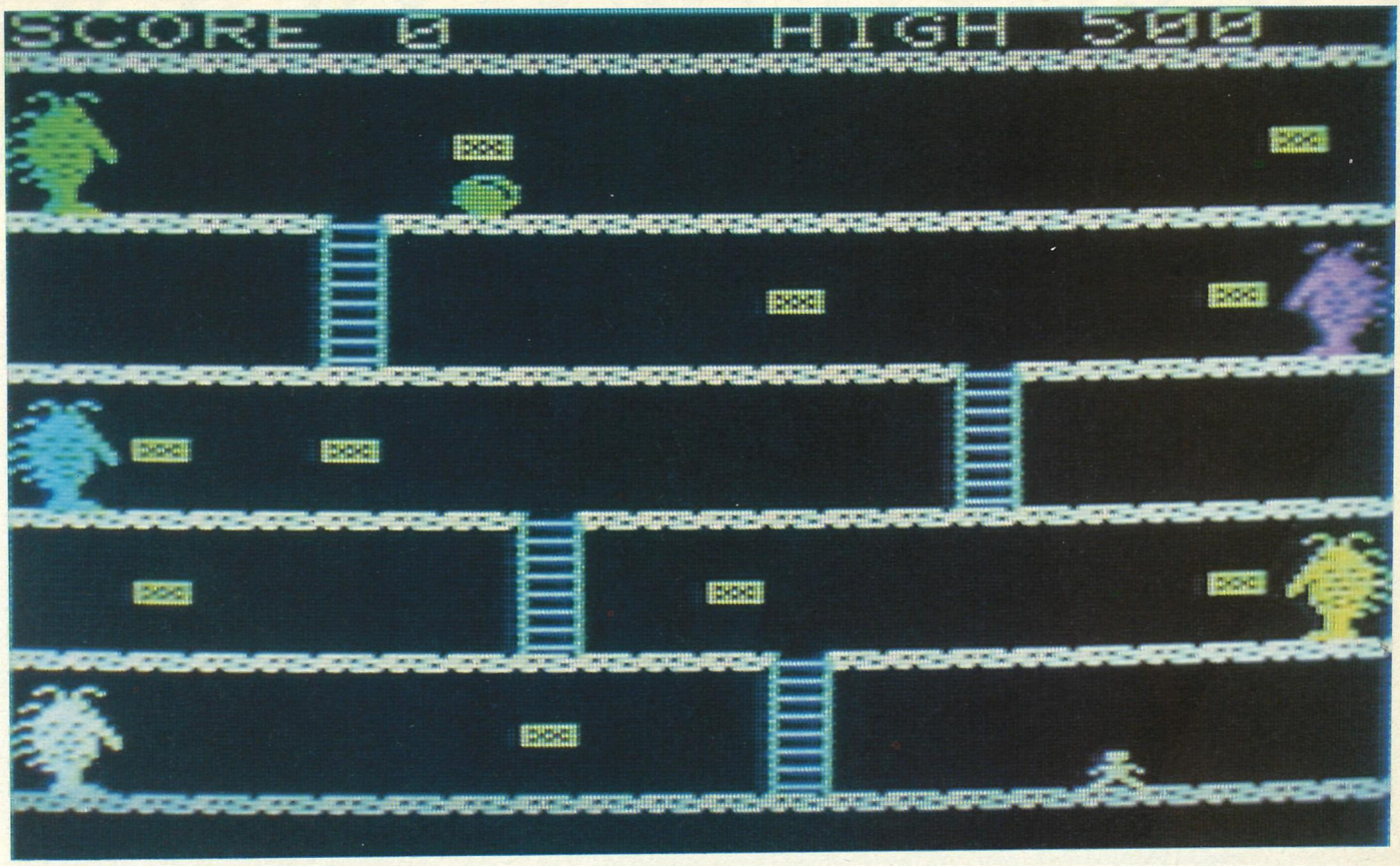
even harder. On the first screen, blocks are worth 50 points, on the second, 100 and so on adding 50 per screen. The play keys are as follows:

P	— up
.	— down
;	— right
L	— left
shift	— jump

When you have lost all three lives, if you have a good score you are asked to input your name for the high score table, which holds the top eight scores with names.

Program 1. Loader.

```
10 PRINT"■":POKE36879,30
20 PRINTTAB(7)"■LADDERS"
30 PRINT"■■IT IS NECESSARY TO
■LOAD & RUN THIS
■PROGRAM BEFORE PLAYING "
40 PRINT"■LADDERS■."
50 PRINT"■■"TAB(6)"■■HIT A KEY■"
60 POKE198,0:WAIT198,1:POKE198,0
70 PRINT"■NOW LOAD 'LADDERS'."
80 FORH=1TO1000:NEXT
90 POKE642,32:SYS64824
```



DDERS

```
9500 PRINT"[illegible]";:POKE36879,30:POKE36869,194:POKE36877,0:POKE36876,0
9505 S$="                                    "
9510 PRINT"[illegible]        L[illegible]        ";S$;"   \ARTIN LIGHTFOOT   ";S$
9520 PRINT"[illegible]DU ARE THE MAN AT THEBOTTOM OF THE SCREEN."
9530 PRINT" DU HAVE TO GO ROUND  GETTING THE BLOCKS"
9540 PRINT"BY JUMPING UP TO THEM.[illegible]FTER CLEARING ONE    LAYER,ANOTHER ONE WILL";
9550 PRINT"APPEAR,WHICH WILL BE  HARDER THAN THE       PREVIOUS ONE."
9560 PRINT"[illegible]OATCH OUT FOR THE     BARRELS!!!"
9570 PRINT"[illegible]"
9580 PRINTTAB(8)"[illegible] - JUMP
9590 GOTO9000
10000 DATA 162,19,202,189,90,16,157,91,16,224,0,208,245,169,32,141,90,16
10005 DATA 173,181,16,201,0,240,5,169,32,141,181,16,162,0,189,177,16,157
10010 DATA 176,16,232,224,19,208,245,173,181,16,201,0,240,5,169,8,141,181
10015 DATA 16,173,104,17,201,0,240,5,169,32,141,104,17,162,0,189,97,17
10020 DATA 157,96,17,232,224,19,208,245,173,104,17,201,0,240,5,169,8,141
10025 DATA 104,17,173,23,17,201,0,240,5,169,32,141,23,17,162,19,202,189
10030 DATA 10,17,157,11,17,224,0,208,245,173,23,17,201,0,240,5,169,8
10035 DATA 141,23,17,173,196,17,201,0,240,5,169,32,141,196,17,162,19,202
10040 DATA 189,186,17,157,187,17,224,0,208,245,173,196,17,201,0,240,5,169
10045 DATA 8,141,196,17,96
```

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*Delete as appropriate

ACE SOUNDS

Richard White and the Acettes run through some of their latest numbers.

THE VOCABULARY of the Ace contains only one word, Beep, that can be used to produce sounds. The control that the user has over the sounds that this word generates is limited to specifying its frequency and duration.

This makes it difficult to produce the kind of sounds that arcade-type games in particular require. The following Ace words were written to allow the user to produce a large range of sounds. At the heart of these words are three short machine-code routines that produce the sound. Associated with them is a variable space that holds the parameters of the sound for the machine code to pick up. A defining word, Sound, transfers data from words defined by it to the variable space when the defined word is called. Different sounds can be produced by the machine-code routine simply by defining Sound words with the required parameters. This also means that once fundamental words have been defined, new sounds can be added using the minimum of additional bytes.

It is mentioned on page 154 of the Ace manual that the diaphragm of the speaker is controllable by In and Out instructions: In pushes the diaphragm in and Out pushes it out. The motion of the diaphragm will be controlled by two machine-code routines, Pause and Note.

Pause regulates the time period between pushing the diaphragm in and out and hence regulates the frequency at this time.

```
        Pause
        LD B, C       65        C contains the
                                delay time
LOOP    DJNZ LOOP     16 254
        RET           201
```

This word is defined as follows:

CREATE PAUSE 65 c, 16 c, 254 c, 201 c,

Note moves the diaphragm and regulates the time for which this frequency is heard.

```
        Note
NOTE    CALL PAUSE    205 PAUSE   Delay
        IN A, (0)     219         Diaphragm
                                  in
        CALL PAUSE    205 PAUSE   Delay
        OUT A, (0)    211         Diaphragm
                                  out
        DEC E         29          E contains
                                  length of
                                  note
        JRNZ NOTE     32 243      NOTE is
                                  continued if
                                  E ≠ 0
        RET           201
```

Defined by:

CREATE NOTE 205 c, PAUSE, 219 c, 205 c, PAUSE, 211 c, 29 c, 32 C, 243 c, 201 c,

Because Create puts the first data address on the stack, the definition of Note using Pause will work. Note that, as the address of Pause is of two bytes, a comma is used instead of c followed by a comma.

These words are used by another machine-code word, Noise, which collects the variables from the variable area and then calls Note, varying the length and frequency of the sound as required.

The word Note requires five parameters so we first create a word with five bytes of memory available.

CREATE VAR 0, 0, 0 c,

The five parameters stored in Var are:

Name	Location	Use
LENGTH	VAR	Specifies length used by Note at start of sound
START	VAR+1	Specifies delay time used by Pause at start of sound
STOP	VAR+2	Specifies delay time at which the sound stops
FINC	VAR+3	Amount by which the delay time is changed each cycle
LINC	VAR+4	Amount by which the length is changed each cycle

The increment parameters are added to the length and frequency parameters each cycle so

(continued on next page)

Below, figure 2, and right figure 1.

```
        Noise
        LD C, 1       14 1        C = initial delay time = 1
        LD H, 1       38 1        H = final delay time = 1
        LD L, 6       46 1        L = initial length = 6
        LD D, 0       22 0        D = length increment = 0
CYCLE   LD E, L       93          Transfer length to E for
        CALL NOTE     205 NOTE    use of Note.
        LD A, L       125         Add the length increment
        ADD A, D      130         to the length and
        LD L, A       111         restore in L.
        LD A, C       121         Add the time delay
                                  increment
        ADD A, 13     198 13      to the time delay and
        LD C, A       79          restore in C.
        CP H          188         Compare present time delay
        JRNZ CYCLE    32 242      with final time delay. If
        JP (IY)       253 233     not equal then cycle, or
                                  else return to Forth.
```

```
Noise   LD A, (START)     58 VAR + 1
        LD C, A           79          C = initial delay time.
        LD A, (STOP)      58 VAR +2
        LD H, A           103         H = final delay time.
        LD A, (LENGTH)    58 VAR + 0
        LD L, A           111         L = initial Note length.
        LD A, (LINC)      58 VAR + 4
        LD D, A           87          D = length increment.
CYCLE   LD E, L           93          Transfer length to E for
        CALL NOTE         205 NOTE    use of Note.
        LD A, L           125         Add the length increment
        ADD A, D          130         to the length and
        LD L, A           111         restore in L.
        LD A, (FINC)      58 VAR + 3  Add the time delay increment
        ADD A, C          129         to the time delay and
        LD C, A           79          restore in C.
        CP H              188         Compare present time delay
        JRNZ CYCLE        32 241      with Stop time delay. If
        JP (IY)           253 233     not equal then Cycle else
                                      return to Forth.
```

(continued from previous page)
that the frequency and length of the frequency changes during the sound. The sound stops when the delay time equals Stop. This means that when defining a sound the user must be sure that this will eventually occur. Stop will eventually be reached for all values of Finc other than powers of two. For powers of two the delay time must equal Stop within one cycle of its 0 to 255 range or the sound will continuously cycle through the same values of frequency. If this occurs, then remove the power supply and reload the program. Let us now look at the word Noise — see figure 1.

This word is defined by:

```
CREATE NOISE 58 c, VAR 1+, 79 c, 58 c,
VAR 2+, 103 c, 58 c, VAR , 111 c, 58 c,
VAR 4+, 87 c, 93 c, 205 c, NOTE, 125 c, 130 c,
111 c, 58 c, VAR 3+, 129 c, 79 c, 188 c, 32 c,
241 c, 253 c, 233 c,
```

The defining word Sound that uses Noise is defined as follows:

```
DEFINER SOUND
DOES>
 5 0
 DO
  DUP I + C@ VAR
  I + C!
 LOOP
 DROP NOISE CALL
;
```

When a word is defined using Sound the parameters of the sound are stored using c followed by a comma. For example, if we want to define a sound A that has the parameters Length 1, Start 1, Stop 255, Finc 1, Linc 0 then this would be done:

```
SOUND A 1 c, 1 c, 255 c, 1 c, 0 c,
```

When this word A is called, Sound transfers these numbers to Var and then calls Noise so that the sound is produced. Note that Noise Call is used instead of defining a word like Code because Noise is the only one of the machine-code routines that we wish to call directly. The other two routines cannot be called directly by the user because they end with Ret instead of JP (IY).

We shall now look at some of the sounds that can be generated using these words. The word A that we just defined gives a short sound whose frequency starts high and then decreases with the length remaining constant at 1. This sound can be lengthened by increasing the length parameter or by introducing a length increment. It can only be shortened by decreasing the difference between Start and Stop. The word A can be used as it is for various purposes, or can be combined with another sound to give a siren effect. This new sound will be similar to A, but the frequency rises instead of falls.

```
SOUND B 1 c, 255 c, 1 c, 255 c, 0 c,
```

Finc equal to 255 is the same as Finc equal to −1. Therefore the frequency will rise. B can also be used alone, but with A can give a siren:

```
:SIREN
 BEGIN
  B A INKEY
 UNTIL
;
```

This gives a continous siren until a key is pressed, but obviously the structure can be changed to give a siren of a specific duration. A different siren effect can be produced by defining a new Sound word.

```
SOUND C 6 c, 1 c, 1 c, 5 c, 0 c,
```

If this is speeded up, then it gives the effect of a machine gun. It can be speeded up by first changing the length as in:

```
SOUND D 1 c, 1 c, 1 c, 5 c, 0 c,
```

or by increasing Finc so that more cycles of the 0-255 range are made before the time delay equals Stop as in:

```
SOUND E 6 c, 1 c, 1 c, 13 c, 0 c,
```

The programs can be used to produce other types of sound also. For example, the following word and words of its type can be used to make the noise that is used when something is completed successfully.

```
SOUND F 35 c, 44 c, 248 c, 15 c, 0 c,
```

Another interesting sound can be produced using:

```
SOUND G 10 c, 240 c, 124 c, 45 c, 0 c,
```

So far all the sounds that we have looked at so far have a Linc equal to zero. This is because a non-zero value of Linc can, if not thought about, give sounds that are much too long. For example,

```
SOUND H 6 c, 1 c, 1 c, 13 c, 13 c,
```

which is Sound E with Linc equal to Finc.

Finc can be used to give reasonable length sounds such as

```
SOUND K 10 c, 250 c, 242 c 18 c, 1 c,
```

but the parameters must be thought of more carefully than when Finc equals zero.

If you find a sound to use and wish to use only that sound in one particular vocabulary then memory space can be saved by embedding the parameters into the routine Noise. For example if you want to use only Sound E then define Pause and Note as before but change Noise as shown in figure 2. ■

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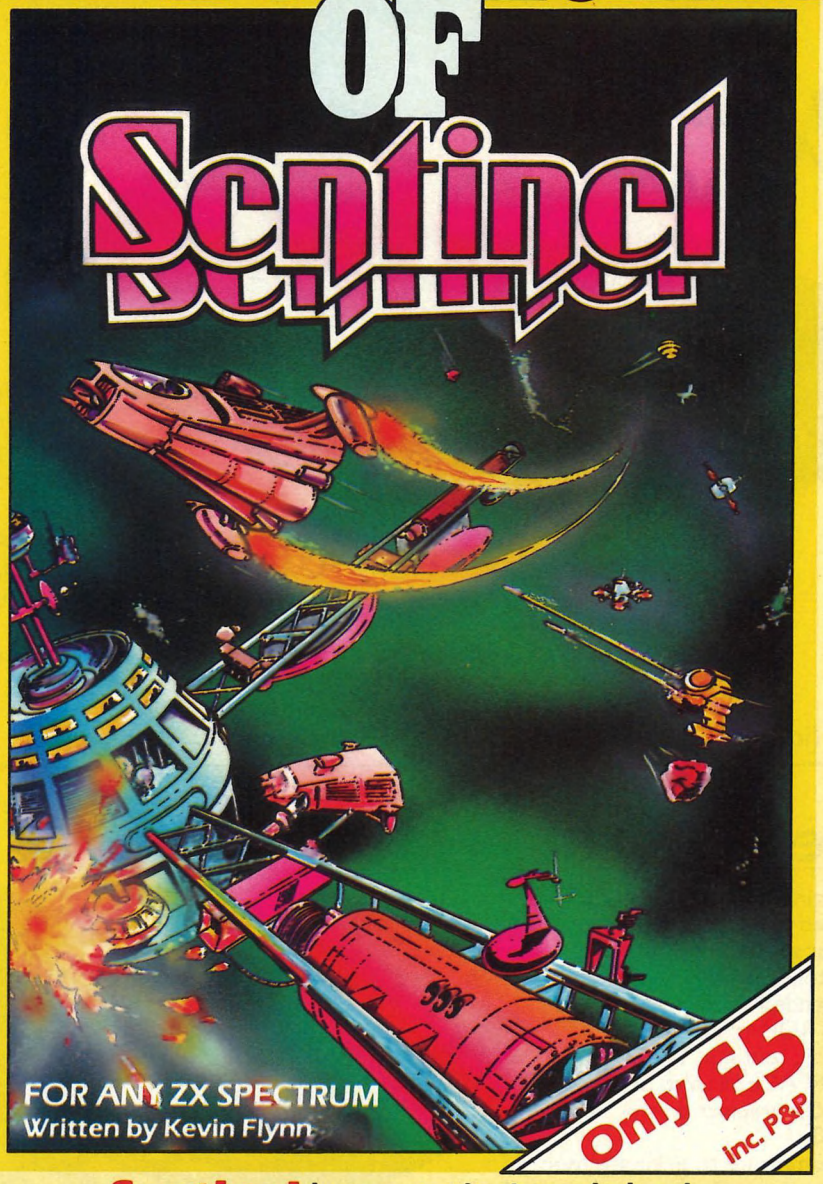

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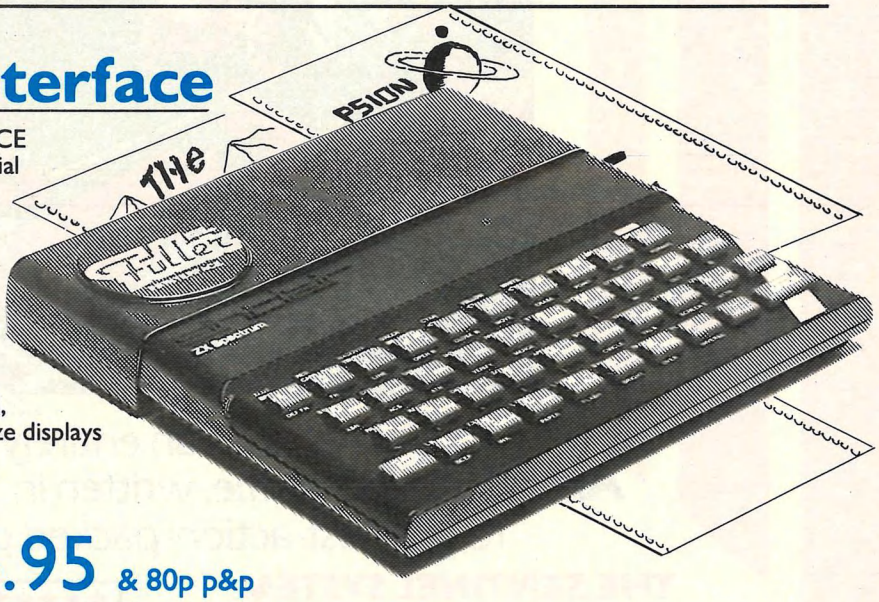

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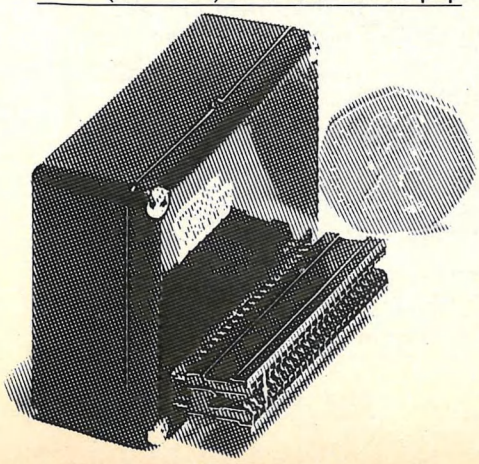

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STAR WARS

```
*******************************
*          MACHINE CODE       *
*******************************

  10 LET A=32400: CLEAR A
  20 INPUT "CODE : ";B: PRINT A,
B: LET A=A+1: GO TO 20
```

32400

```
6,64,17,0,64,213,225,35,197,1,31
,0,26,237,176,43,119,0,35,35,19,
193,16,240,201
```

32425

```
6,64,17,255,71,213,225,43,197,1,
31,0,26,237,184,35,119,0,43,43,2
7,193,16,240,201
```

32450

```
6,64,17,0,72,213,225,35,197,1,31
,0,26,237,176,43,54,0,35,35,19,1
93,16,240,201
```

32475

```
6,64,17,255,79,213,225,43,197,1,
31,0,26,237,184,35,54,0,43,43,27
,193,16,240,201
```

32500

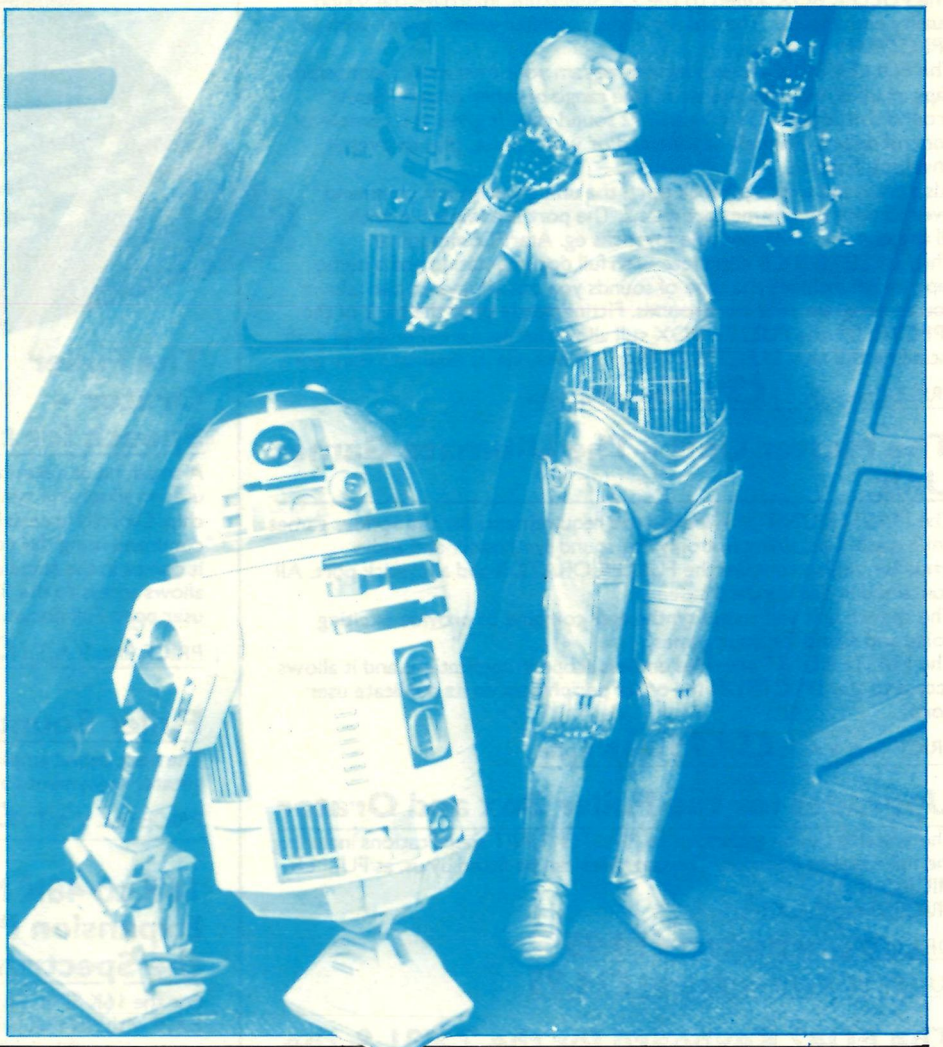
```
6,1,197,33,0,1,17,4,0,229,205,18
1,3,225,17,16,0,167,237,82,32,24
0,193,16,233,201,0,0,0,0
```

32530

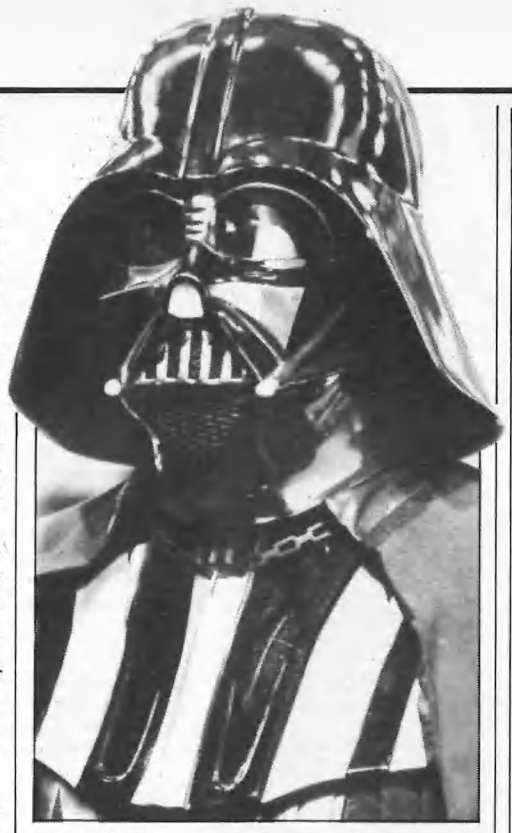
```
6,1,197,33,0,3,17,1,0,229,205,18
1,3,225,17,16,0,167,237,82,32,24
0,193,16,233,201,0,0,0,0
```

32560

```
6,2,197,33,15,0,17,1,0,229,205,1
81,3,225,17,4,0,167,237,90,125,2
54,255,32,237,193,16,230,201,0

*******************************
*        CHARACTER SET        *
*******************************

  10 LET A=USR "A":
  20 INPUT "CODE : ";B: PRINT A,
B: LET A=A+1: GO TO 20
A £   14,28,28,28,0,24,60,126
B %   80,40,40,56,0,24,36,126
C ¢   7,7,15,31,27,14,14,14
D ½   160,160,112,168,136,112,80,
80
E ¾   2,2,1,3,3,7,7,7
F ¼   144,48,240,80,80,80,16,240
G ,   0,0,0,0,1,1,3,2
H ©   0,7,24,106,138,8,235,42
I ®   0,254,1,245,149,1,249,9
J ™   0,0,128,64,32,16,104,84
K ¶   4,4,8,15,7,0,1,2
L ¥   10,11,8,255,254,254,230,19
M ±   9,249,1,255,171,171,171,254
N ÷   84,119,4,7,255,248,240,16
O ×   124,202,149,137,171,254,0,0
P ¶   24,100,130,145,77,137,182,6
4
Q ©   0,24,100,134,41,196,139,112
R ▲   0,24,60,126,255,0,0,0
S ▼   0,0,0,255,126,60,24,0
T ▬   0,0,0,0,255,255,0,255

  10 REM ***********************
         * > BATTLE ON HOTH < *
         ***********************?
  20 REM
         DUNCAN KINNAIRD 1983
  30 PAPER 7: INK 7: CLS : BORDE
R 0: LOAD ""SCREEN$
  40 IF INKEY$="" THEN GO TO 40
  80 INPUT "DIFFICULTY (1 TO 5)"
;X: INPUT "TIME (100 +)";T
  90 INK 0: OVER 0: PAPER 7: FOR
 F=1 TO 15: PRINT AT F,0;"
                                 ": NEX
T F
  95 RESTORE
 100 LET Z=0: LET S=0: LET M=100
: PAPER 7: LET A=-20: LET B=-40:
LET C=-60: LET D=-60: LET E=-10
0: LET F=X: LET G=F: LET H=F: LE
T I=F: LET J=F: LET M=79: LET N=
0
 120 PLOT 0,128: FOR Q=0 TO 30:
READ R: DRAW 8,R: NEXT Q: DRAW 7
,5: DATA 2,3,4,3,1,-1,-3,-2,-4,-
2,-1,1,-1,-1,0,2,2,1,0,-1,-1,-2,
-5,-5,0,0,1,1,2,2,-1
 200 BEEP .5,0: BEEP .5,7: BEEP
.2,5.2: BEEP .2,3.2: BEEP .2,1.5
: BEEP .5,10.1: BEEP .3,5
 210 BEEP .2,5.2: BEEP .2,3.2: B
EEP .2,1.5: BEEP .5,10.1: BEEP .
6,5
 220 BEEP .2,5: BEEP .2,4: BEEP
.22,5: BEEP .7,1.5
2000 PRINT AT 17,26; OVER 0; PAP
ER 1; INK 7; BRIGHT 1;"©▲"; INK
 3;"©": OVER 1
2010 LET L=0
2050 FOR K=0 TO 4
2055 LET Q=K
2060 GO SUB 9350
2065 LET Q=0: GO SUB 2820
2070 GO SUB 9400: LET A=A+1: LET
 B=B+1: LET C=C+1: LET D=D+1: LE
T E=E+1
2072 IF IN 63486<>255 OR IN 6143
8<>255 THEN GO SUB 2800
2075 GO SUB 9350
2080 RANDOMIZE 0*USR 32425: RAND
OMIZE 0*USR 32475
2090 GO SUB 9200
2100 NEXT K
2110 IF IN 32766<>255 THEN GO SU
B 2912: GO TO 3000
2150 GO TO 2050
2700 LET R=P*8+8: IF RND<.7 THEN
 GO TO 2710
2701 INK 4: LET Q=INT (RND*8)-3:
 PLOT R,74: DRAW 255-R,0: RANDOM
IZE USR 32500: INK 0: PLOT R,74:
 DRAW 255-R,0: IF M>=77 THEN GO
TO 2710
2702 IF M<=69 THEN GO TO 2710
2703 GO SUB 2750
2710 LET Q=INT (RND*8)+8: LET R=
INT (RND*10)+10: PRINT AT Q,R; P
APER 6; INK 2; BRIGHT 1;"©";AT Q
,R; INK 0; PAPER 7; BRIGHT 0;"©"
2720 RETURN
2750 RANDOMIZE 0*USR 32560: RAND
OMIZE 0*USR 32560: LET N=-5: RET
URN
2790 IF Q=0 THEN RETURN
2795 RANDOMIZE 0*USR 32560: LET
Z=Z+10: PRINT AT 20,26; PAPER 6;
 INK 2;"*HIT*": RETURN
2800 INK 2: PLOT 119,M: DRAW -11
9,0: RANDOMIZE 0*USR 32530: INK
0: PLOT 119,M: DRAW -119,0
2805 IF M<>79 THEN RETURN
2810 LET Q=1
2820 LET P=0
2822 IF A>=6 THEN IF A<=14 THEN
LET F=F-Q: IF F>=1 THEN LET P=A:
 GO SUB 2790
2823 IF F=0 THEN LET P=A: GO TO
2847
2825 IF B>=6 THEN IF B<=14 THEN
LET G=G-Q: IF G>=1 THEN LET P=B:
 GO SUB 2790
2826 IF G=0 THEN LET P=B: GO TO
2847
2830 IF C>=6 THEN IF C<=14 THEN
LET H=H-Q: IF H>=1 THEN LET P=C:
 GO SUB 2790
2831 IF H=0 THEN LET P=C: GO TO
2847
2835 IF D>=6 THEN IF D<=14 THEN
LET I=I-Q: IF I>=1 THEN LET P=D:
 GO SUB 2790
2836 IF I=0 THEN LET P=D: GO TO
2847
2840 IF E>=6 THEN IF E<=14 THEN
LET J=J-Q: IF J>=1 THEN LET P=E:
 GO SUB 2790
2841 IF J=0 THEN LET P=E: GO TO
2847
2845 IF Q=0 THEN GO TO 2700
2846 OVER 0: PRINT AT 20,26; PAP
ER 2;"      ": OVER 1: RETURN
2847 BEEP .01,0: OVER 0: LET P=P
-5: INK 2: PAPER 7: PRINT AT 11,
P; INK 0;"      ";AT 12,P;"▟▙▟▙";
 BRIGHT 1; PAPER 6;"©";AT 13,P;"
▟▙▟▙"; PAPER 6;"▟▙▟▙";AT 14,P;"▟▙▟▙
";AT 15,P;"▟▙▟▙"
2850 BEEP .01,-1: PRINT AT 12,P;
 INK 0;"      ";AT 13,P;"▟▙▟▙"; PAP
ER 6; BRIGHT 1;"©©";AT 14,P;"▟▙▟▙"
```



Duncan Kinnaird's Spectrum game celebrates *The Return of the Jedi* — the latest Star Wars film — with the return of the mechanical camels which terrorised the Planet Hoth.



BASED ON the battle in *The Empire Strikes Back* in which Imperial Walkers — large armoured vehicles with legs — engage rebel forces, this program was written on a 48K Spectrum with user graphics for 48K. But it will run on any Spectrum.

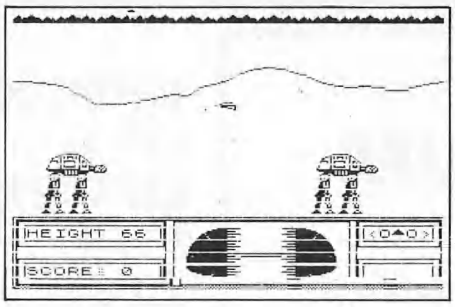
You are the pilot of the last remaining rebel snowspeeder and have to distroy five of the Imperial AT-AT walkers before your time runs out. Flying your snowspeeder is the same as flying most conventional atmosphere craft. In the centre of the control panel is the rate of descent/ascent instrument which reads between a rate of descent of eight metres per second and a rate of ascent of eight metres per second.

The snowspeeder can be turned round but this, from a flying point of view, can take a struggle. Your flying is made more difficult because of the Imperial fire power, which consists of flak and heavy laser cannons. When hit, your rate of ascent suddenly decreases and you have to prevent yourself from plummeting into the ground.

Destroying the Walkers demands excellent flying skills. You have to fly at a height of 28 metres, just above enemy fire, and shoot into the head.

At the beginning of the game you will be asked the difficulty of the game. This refers to the number of direct hits the walkers must suffer before falling. You will then be asked for the time in which you have to destroy the walkers. About 400 is recommended for the first game. The order of programming is as follows:

1. Use machine-code loader to enter code to program the lateral scrolling.
2. Use loader and code to enter the user graphics.
3. Write in the main program.
4. Save all so far by entering = GOTO 9990
5. Enter the screen construction program and run. Save the screen straight after the program so far by entering: Save "screen"SCREEN$
6. to start game enter: GOTO 40. ■

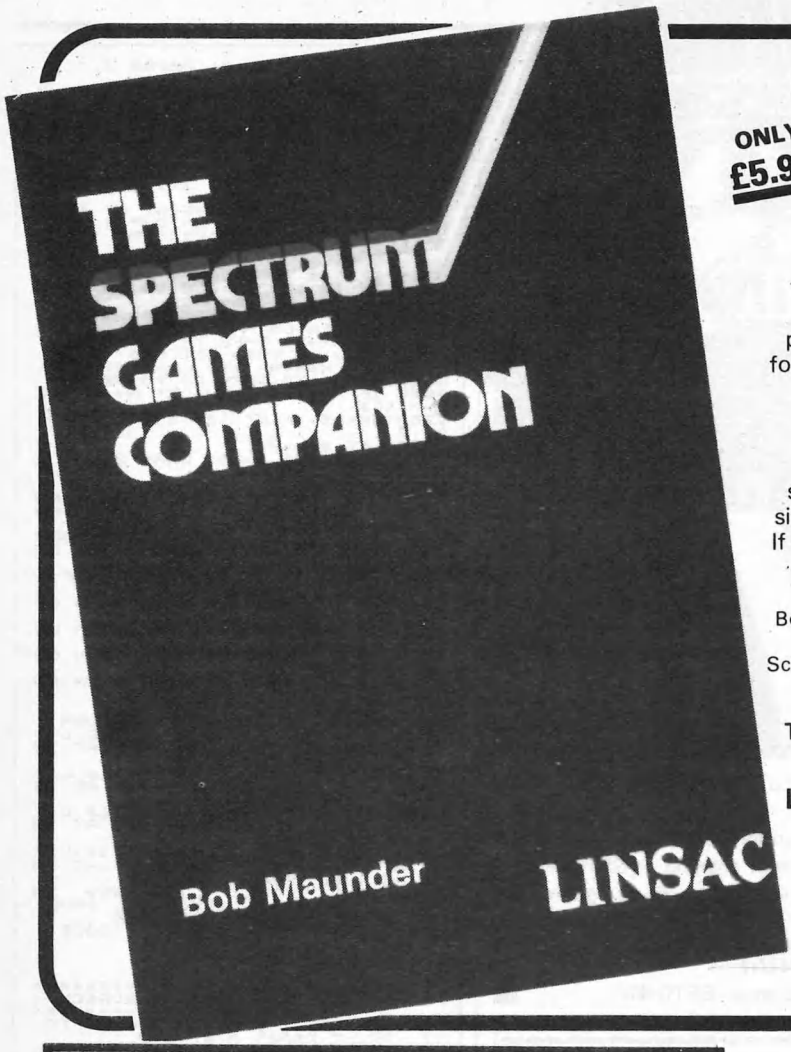



```
; PAPER 6; BRIGHT 1;"@@@";AT 15,
P; BRIGHT 1; PAPER 6;"@@@@"
2855 BEEP .01,-2: PRINT AT 13,P;
 INK 0;"      "; PAPER 6;AT 14,P;
"@"; BRIGHT 1;"@@";AT 15,P;"@@"
; BRIGHT 1;"@@"
2860 BEEP .01,-3: PRINT AT 14,P;
 INK 0;"      "; PAPER 6;AT 15,P;
"@@"; BRIGHT 1;"@@"
2870 INK 0: PRINT AT 15,P;"@@@"
2880 LET Z=Z+10: PRINT AT 20,8;Z
: IF F<=0 THEN IF G<=0 THEN IF H
<=0 THEN IF I<=0 THEN IF J<=0 TH
EN GO TO 9150
2899 GO TO 2822
2900 IF A=0 THEN IF F>=1 THEN GO
 TO 2910
2903 IF B=0 THEN IF G>=1 THEN GO
 TO 2910
2905 IF C=0 THEN IF H>=1 THEN GO
 TO 2910
2907 IF D=0 THEN IF I>=1 THEN GO
 TO 2910
2908 IF E=0 THEN IF J>=1 THEN GO
 TO 2910
2909 RETURN
2910 PAPER 7: PRINT AT 12,0;"@":
 RETURN
2912 IF A=35 THEN IF F>=1 THEN G
O TO 2922
2914 IF B=35 THEN IF G>=1 THEN G
O TO 2922
2916 IF C=35 THEN IF H>=1 THEN G
O TO 2922
2918 IF D=35 THEN IF I>=1 THEN G
O TO 2922
2920 IF E=35 THEN IF J>=1 THEN G
O TO 2922
2921 RETURN
2922 PAPER 7: PRINT AT 11,31;"/"
;AT 12,31;"&";AT 13,31;"]";AT 14
,31;"#";AT 15,31;"$"
2923 RETURN
3000 LET L=31
3010 PRINT OVER 0; PAPER 1; INK
3; BRIGHT 1;AT 17,26;"<O"; INK 7
;"▲O>"
```

```
3050 LET O=4: FOR K=35 TO 31 STE
P -1
3060 GO SUB 9360
3065 LET Q=0: GO SUB 2820
3070 GO SUB 9400: LET O=O-1: LET
 A=A-1: LET B=B-1: LET C=C-1: LE
T D=D-1: LET E=E-1
3072 IF IN 61436<>255 OR IN 6348
6<>255 THEN INK 2: PLOT 136,M: D
RAW 119,0: RANDOMIZE 0*USR 32530
: INK 0: PLOT 136,M: DRAW 119,0
3075 GO SUB 9360
3080 RANDOMIZE 0*USR 32400: RAND
OMIZE 0*USR 32450
3090 GO SUB 9200
3100 NEXT K
3110 IF IN 65278<>255 THEN GO SU
B 2900: GO TO 2000
3150 GO TO 3050
9000 FLASH 1: OVER 0: INK 2: PRI
NT AT 15,15; PAPER 6; BRIGHT 1;"
@@": FOR F=0 TO 5: PLOT 128,50:
DRAW INT (RND*60)-30,INT (RND*20
)+8: NEXT F: FOR F=0 TO 4: RANDO
MIZE 0*USR 32550: NEXT F: PRINT
PAPER 2; INK 7;AT 17,6;"0";AT 2,
8; FLASH 1; BRIGHT 1; PAPER 1; I
NK 7;"DEFENCES BROKEN": GO TO 91
00
9050 OVER 0: FLASH 1: PRINT AT 2
,0; PAPER 2; INK 6;">TIME OUT- G
ENERATORS DESTROYED<"
9100 BEEP .5,0: BEEP .5,7: BEEP
.2,5.2: BEEP .2,3.2: BEEP .2,1.5
: BEEP .5,10.1: BEEP .75,5
9110 OVER 0: PRINT AT 4,3; PAPER
 1; INK 7; BRIGHT 1;"* REBEL FOR
CES WIPED OUT *"
9120 OVER 0: PAUSE 100: INK 6: P
RINT AT 6,1; PAPER 4;"* Press an
y key to try again *": FLASH 0:
PAPER 2: PRINT AT 17,8;"  ": FO
R f=17 TO 20: PRINT AT f,17;"
": NEXT f: PRINT AT 21,17;"═══"
9130 IF INKEY$<>"" THEN GO TO 91
30
9135 IF INKEY$="" THEN GO TO 913
5
```

```
9140 PRINT AT 20,8; PAPER 2;"
": GO TO 80
9150 OVER 0: FLASH 1: PRINT AT 2
,5; PAPER 7; INK 1;"IMPERIAL FOR
CES DOWNED";AT 4,0; BRIGHT 1; IN
K 6; PAPER 2;"*EVACUATION OF HOT
H PROCEEDING *": GO TO 9120
9200 LET T=T-1
9205 PAPER 2: INK 7: OVER 0: PRI
NT AT 17,8;"  ";AT 17,8;M-51;AT
 20,8;Z
9206 IF N<=-1 THEN PRINT AT 17,2
8; PAPER 1; INK 7; BRIGHT 1;"▼"
9208 IF N>=1 THEN PRINT AT 17,28
; PAPER 1; INK 7; BRIGHT 1;"▲"
9210 OVER 1
9215 IF T=0 THEN GO TO 9050
9220 IF IN 65022<>255 OR IN 4915
0<>255 THEN LET N=N-1
9230 IF IN 64510<>255 OR IN 5734
2<>255 THEN LET N=N+1
9231 IF N<=-9 THEN LET N=-8
9232 IF N>=9 THEN LET N=8
9235 LET M=M+N+(RND>.2)-(RND>.2)
9240 IF M<=50 THEN GO TO 9000
9250 IF M>=164 THEN LET N=-1: LE
T M=164
9255 INK 6: PLOT 136,S+23: DRAW
23,0
9260 LET S=N*2
9270 PLOT 136,S+23: DRAW 23,0: I
NK 0
9300 RETURN
9350 PLOT 120,M: DRAW 12,0: DRAW
 0,-3: DRAW -10,3: DRAW 4,2: DRA
W 4,0: RETURN
9360 PLOT 135,M: DRAW -12,0: DRA
W 0,-3: DRAW 10,3: DRAW -4,2: DR
AW -4,0: RETURN
9400 PAPER 7: IF A=K THEN IF F>=
1 THEN GO SUB 9500+O
9410 IF B=K THEN IF G>=1 THEN GO
 SUB 9500+O
9420 IF C=K THEN IF H>=1 THEN GO
 SUB 9500+O
9430 IF D=K THEN IF I>=1 THEN GO
 SUB 9500+O
9440 IF E=K THEN IF J>=1 THEN GO
 SUB 9500+O
9450 RETURN
9500 PRINT AT 12,L;"@": RETURN
9501 PRINT AT 11,L;"%";AT 12,L;"
#";AT 13,L;"]";AT 14,L;"$";AT 15
,L;"&": RETURN
9502 PRINT AT 11,L;"@";AT 12,L;"
@";AT 13,L;"]";AT 14,L;"#";AT 15
,L;"$": RETURN
9503 PRINT AT 11,L;"%";AT 12,L;"
#";AT 13,L;"]";AT 14,L;"$";AT 15
,L;"&": RETURN
9504 PRINT AT 11,L;"/";AT 12,L;"
%";AT 13,L;"]";AT 14,L;"#";AT 15
,L;"$": RETURN
9990 SAVE "BATTLE" LINE 9999: SA
VE "      ON"CODE 32400,190: SAVE
"    HOTH"CODE USR "A",21*8
9999 LOAD ""CODE : LOAD ""CODE :
 RUN
```

```
  10 REM ***********************
         * DASH-PANEL & SCREEN *
         ***********************
 100 PAPER 7: CLS : FOR L=15 TO
21: PRINT PAPER 2;AT L,0;"  ": NEX
T L
 110 INK 6: PLOT 0,0: DRAW 255,0
: DRAW 0,46: DRAW -255,0: DRAW 0
,-46: DRAW 2,2: DRAW 251,0: DRAW
 0,42: DRAW -251,0: DRAW 0,-42
 120 PLOT 3,3: DRAW 87,0: DRAW 0
,15: DRAW -87,0: DRAW 0,-15: PLO
T 3,27: DRAW 87,0: DRAW 0,15: DR
AW -87,0: DRAW 0,-15
 130 PLOT 7,7: DRAW 0,9: DRAW 81
,0: DRAW 0,-9: DRAW -81,0: PLOT
7,31: DRAW 0,9: DRAW 81,0: DRAW
0,-9: DRAW -81,0
 140 PRINT FLASH 1; INK 2;AT 17,
1;"HEIGHT";AT 20,1;"SCORE>";CHR$
 8; OVER 1;"<"
 150 PLOT 96,3: DRAW 103,0: DRAW
0,40: DRAW -103,0: DRAW 0,-40
 160 INK 7: LET A=168: FOR F=0 T
O PI STEP PI/270
 170 PLOT A,17: DRAW 23*COS F,22
*SIN F
 180 IF F>=PI/2 THEN LET A=127
 190 NEXT F
 200 INK 1: LET A=127: FOR F=PI
TO 2*PI STEP PI/200: PLOT A,15:
DRAW 23*COS F,7*SIN F: IF F>=PI+
PI/2 THEN LET A=168
 210 NEXT F
 220 INK 6: FOR F=7 TO 39 STEP 4
: PLOT 128,F: DRAW 7,0: PLOT 160
,F: DRAW 7,0: NEXT F
 230 FOR F=9 TO 37 STEP 4: PLOT
128,F: DRAW 4,0: PLOT 163,F: DRA
W 4,0: NEXT F
 240 PLOT 204,3: DRAW 48,0: DRAW
 0,16: DRAW -48,0: DRAW 0,-16: P
LOT 207,7: DRAW 0,9: DRAW 41,0:
DRAW 0,-9: DRAW -41,0
 250 PLOT 204,27: DRAW 48,0: DRA
W 0,16: DRAW -48,0: DRAW 0,-16:
PLOT 207,31: DRAW 0,9: DRAW 41,0
: DRAW 0,-9: DRAW -41,0
 260 PRINT AT 17,26; PAPER 1; IN
K 7; BRIGHT 1;"<O▲"; INK 3;"O>"
 270 INK 6: PLOT 203,2: DRAW 0,4
1: PLOT 91,2: DRAW 0,41
 280 FOR F=USR "A" TO USR "D"+7:
 READ A: POKE F,A: NEXT F: DATA
0,16,56,123,255,255,255,0,0,0,8,
29,191,255,255,0,0,48,120,255,25
5,255,255,0,0,24,60,126,255,0,0,
0
 290 PRINT AT 0,0; BRIGHT 1; PAP
ER 5; INK 7;"[illegible]"; I
NK 5;"▲#"; INK 7;"[illegible]
#"
 300 PRINT AT 2,5; INK 2;"BF
ITTLE
ON
HOTH"
 310>PRINT FLASH 1; BRIGHT 1;AT
12,1; INK 1;"X<= DUNCAN KINNAIR
D 1983 =>X";AT 14,3; INK 4; PAP
ER 6;"* Press any key to begin *
"
```



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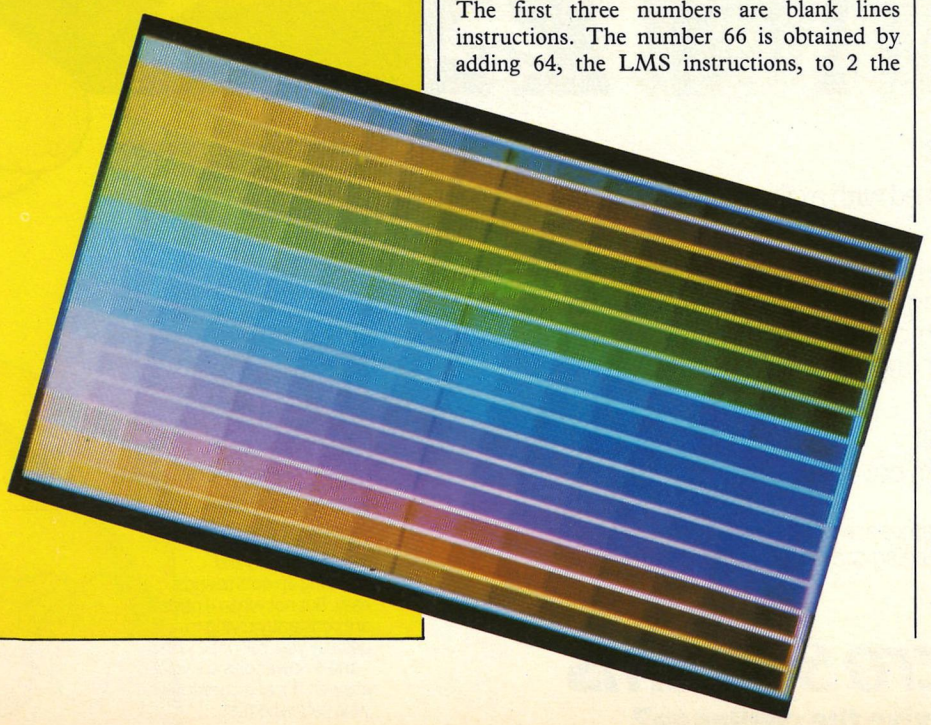
Chris Lam shows spectacularly how you can mix several different graphic modes on screen simultaneously to produce effects you never imagined possible.

ATARI SCREEN MIXTURE

```
5 REM ATARI DISPLAY LIST.
6 REM Program:1
10 GRAPHICS 8+16
15 SETCOLOR 4,9,4
20 DLIST=PEEK(560)+256*PEEK(561)
30 POKE DLIST+3,64+7
40 POKE DLIST+6,7
50 POKE DLIST+7,6
60 POKE DLIST+8,6
70 FOR N=9 TO 12:POKE DLIST+N,2:NEXT N
80 POKE DLIST+127,65
90 POKE DLIST+128,PEEK(560)
100 POKE DLIST+129,PEEK(561)
1000 POKE 752,1
1001 POSITION 0,0:POKE 87,2:? #6;"1ST GR
APHICSTWO LINE";
1010 ? #6;"2ND GRAPHICSTWO LINE";
1020 POKE 87,1:? #6;"1st graphicsone lin
e";
1030 ? #6;"2nd graphicsone line";
1040 POKE 87,0
1050 FOR N=2 TO 5:POSITION 10,N:? #6;"GR
APHICS ZERO LINE";N-1:NEXT N
1060 POKE 87,8:COLOR 1
1070 PLOT 110,40:DRAWTO 200,40
1080 DRAWTO 200,100:DRAWTO 110,100:DRAWT
O 110,40
1090 GOTO 1090
```

```
0 REM ATARI DISPLAY LIST.
1 REM Program:2
10 GRAPHICS 1+16
20 DLIST=PEEK(560)+256*PEEK(561)+4
30 POKE DLIST-1,64+5
40 FOR N=2 TO 12:POKE DLIST+N,5:NEXT N
45 POKE DLIST+13,65
46 POKE DLIST+14,PEEK(560)
47 POKE DLIST+15,PEEK(561)
50 FOR N=1536 TO 1543:POKE N,228:NEXT N:
REM SINGLE CHARACTER
60 SETCOLOR 2,0,15:SETCOLOR 1,0,12:SETCO
LOR 0,0,8:SETCOLOR 4,0,0
70 POKE 756,6
80 FOR N=1 TO 480:? #6;"";:NEXT N
90 GOTO 90
```



IT IS possible to design your own Atari display list by combining several different graphics modes — a great boost to the machine's versatility.

This display list tells Antic, how to display screen RAM. There are three major instructions and 13 different graphics modes which we will refer to as Antic modes. Let us take a look at a Graphics 0 display list.

112, 112, 112, 66, SCRLO, SCRHI, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 65, DLISTLO, DLISTHI.

The first three numbers are blank lines instructions. The number 66 is obtained by adding 64, the LMS instructions, to 2 the Antic mode number for GR.0. LMS stands for load memory scan, see *Your Computer* May 1983. ScrLo and ScrHi together point to the start of screen RAM. Next there are 23 two's that is, 23 GR.0 lines. The number 65 is the jump instruction followed by two bytes which together point to the start of the display list.

Now a bit about screen layout. The Atari computer displays 192 scan lines; each scan line has 160 colour clocks or pixels. Since GR.0 has eight scan lines per line, there are 24 lines — see figure one. Gr.0 also has four colour clocks per character which gives us 40 characters per line. We will call a group of scan lines a line.

The user is not restricted to a display list of all twos or sevens. These can be combined in any fashion to make up a custom display list. Look at figure 1.

Type in program 1. The screen is divided into four parts; the top two lines are in GR.2, next two lines are in GR.1 and the next four are in GR.0. The rest of the screen is in GR.8.

No doubt, you are dying to know how it was done. Line 10 first of all executes a graphics statement that uses up the most memory. In this case, it is clearly Graphics 8+16. Line 20 finds the beginning of the display list. Line 30 Pokes in the LMS instruction plus the Antic mode of the top line of display, that is, 7 for GR.2.

Line 40 Pokes in the second GR.2 line after the two LMS operands.

Lines 50 and 60 Poke in the next two GR.1 lines, and line 70 Pokes in four GR.0 lines.

(continued on page 112)

Let battle

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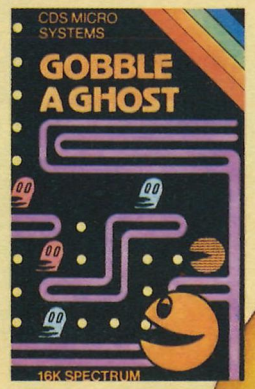

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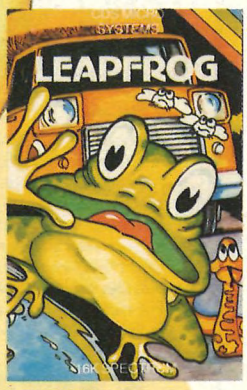

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and we'll keep on coming to get you!

(continued from page 109)

Line 80 is probably the most complicated part. The screen can only display 192 scan lines. The top two lines take up 32, the next two take up 16 and the next four take up 32 totalling 80 scan lines. Therefore we are left with 192 minus 80 which equals 112.

That means we have to put the Jump instruction after the 112th 15 — the Antic mode for GR.8. This location in the display list is the start of the display list plus three — blank lines — plus another three — LMS plus operands — plus seven — the next seven lines — plus 112. This comes out as

DLIST + 129

If you try to display more than 192 scan lines then the screen will roll.

Line 90 gives the low, high of start of display list. And there we have it. Try changing stuff in the program and learn from experimenting.

One more point. Poke 87 with the graphics mode you are about to use — not the Antic mode. To print something to the screen use:

PRINT # 6; "<YOUR TEXT>"

Also position the cursor carefully. You notice that we have kept to multiples of two in our display list. This is because Antic retrieves 48 bytes per line. To keep it happy we have to keep to this, else lines will shift 20 bytes to the right.

Text display experiments

You have probably noticed that Basic does not support some of the graphics modes. Antic mode 3 is a 40 by 19 text display. It uses 10 scan lines per character square. So if a character has an ASCII value between 96 and 127 or 224 and 255 — which conveniently sits on top of the lower case letters — then the top scan lines of the character square are left blank and are instead displayed at the two bottom scan lines of the character square. Set up the display list to show 19 Antic mode 3 lines and experiment. You, of course, have to redefine the lower case letters to get true descenders.

Figure 1.

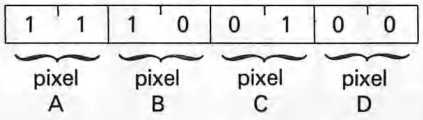
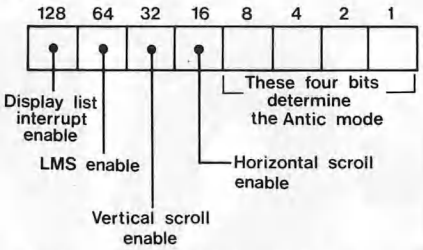


Figure 2.



Antic mode 4 is very interesting. It allows the user to put up to four colours in to one character square. The character definitions are almost the same as in GR.0 but two bits are used to determine the colour of one colour clock.

Figure 1 illustrates how Antic breaks down a byte into four sets of bits. Pixel A will display the colour set by Setcolor 2. Pixel B will display the colour set by Setcolor1. Pixel C will display the colour set by Setcolor 0. Pixel D will display the background colour. If the most significant bit of the character code is set then pixel A will display the colour set by Setcolor 3. Type in program 2 and see how it works. A completely new character set has to be defined, although I have just defined one character.

Most significant bit

Antic mode 5 is the same as 4 but each character is twice as high giving a screen format of 40 characters per line multiplied by 12 lines. Now for a closer look at display list bytes.

The most significant bit — MSB — is the one on the far left in figure 2. This enables the display list interrupt and allows the user to exploit probably the most powerful feature on Atari computers. The next MSB is the LMS enabler.

Now you know why you keep adding 64 for the LMS instruction. The next two bits are fine scroll enablers. The lower four bits together determine Antic mode, for that line.

One more point to mention is the combination of graphics modes 0-8 with GR.9, 10 and 11. This is not as simple as it may seem and requires a display list interrupt to cope with it. Where are GR.9, 10 or 11 in figure 1?

So dig up your old games programs and brighten them up visually. Use either GR.1 or 2 for score and put it at the top of the screen. Use Antic modes 4 or 5 for colourful graphics without the hassle of plotting on to a high-resolution screen. ■

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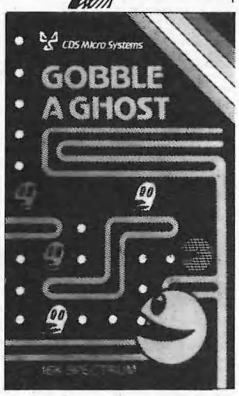

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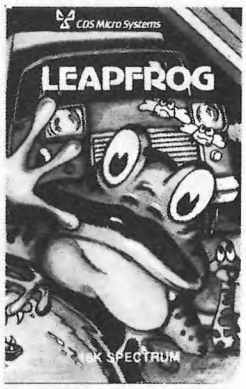
The giant caterpillar is coming to get you, helped by a horde of weird creatures. Destroy it segment by segment, blast a way through the mushrooms, kill off the ugly creatures. But don't relax . . . there's danger everywhere!

3



LEAPFROG
A frog meets many dangers on his way home. Like 4 lanes of fast moving traffic, a swirling log-filled river, plus diving turtles, frog-eating snakes and nasty alligators. Do you have the skills to see him home safely?

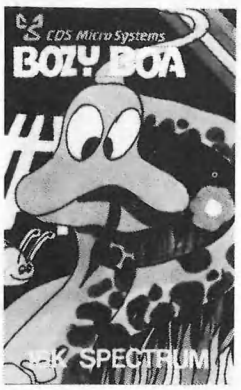
4

OTHELLO
Two players locked in combat . . . one plays black, the other white. Only one colour will dominate. But which? Quick thinking is the key to this exciting game of skill and strategy. Especially when you challenge the computer itself.

5

PAINTER
The bonus score is ticking away as you help the panicky painter paint the 3D maze. Can you finish before it hits zero? Will the computer outwit you? And look out — the game goes faster as you get better!

6



BOZY BOA
It's hectic being a boa in an English country garden. If your lucky you'll find juicy beetles and snails. Quick left then right and in between the flowers. In a couple of hours you'll be boz-eyed like me!

and we'll keep on coming to get you!

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DESPITE ITS small screen size and memory, the Vic-20 has a number of added goodies, which make up for what some may consider to be shortcomings. The RS-232 interface, serial bus, real keyboard, and a wide range of peripherals form a considerable part of these compensations, and the screen has some features only available on more expensive machines such as the BBC. For example, the screen size may be changed from a single character to a wide expanse covering the whole of your TV screen; or it can be narrowed down to a small slit for arcade games. Another feature is the ease with which several screens can be defined at once and flipped, giving some spectacular effects.

The maximum number of screens you can have in memory at any one time is, for practical purposes, eight.

The Visual Interface Chip — 6561 — is the heart and soul of the Vic-20. It generates everything you see and hear from your TV. To do this, it has an on-chip DMA — direct memory access — controller. If you look at figure 1 you will see that the address bus is split into two parts, one part addressable only by the 6502 processor, the other addressable by both the VIC — the chip itself, that is, not the Vic-20 — and the microprocessor. When the VIC wants to generate the screen it needs to access screen memory. Obviously if both the VIC and 6502 tried to address the memory at the same time this would lead to some confusion. So the VIC has to have some way of telling the processor where to set off. It does this by controlling clock cycles. The 6502's activity is choreographed by the clock, and the clock is controlled by the VIC. So when the VIC wants access to memory it floats the tri-state address bus. The VIC can now address the bus safe in the knowledge that the processor will not attempt to access memory.

This DMA facility is why the Vic-20 is so fast compared with many other computers where the screen generation is taken care of by the processor. If the screen is generated by an interrupt facility the processor has to drop what it is doing refresh the screen and then jump back to where it was, recovering all the registers. Although the processor is inactive during DMA, when the DMA finishes all the registers are exactly the same, and the processor can continue as if nothing has occurred.

So now the VIC has control of the bus, how does it address the RAM? There are two registers on the VIC which control the screen start address :36869 and 36866 — see figure 2. The top four bits — nibble — of register 36869 control which block of 1K RAM the screen resides in. When the VIC generates the address, these four bits correspond to address bits 13-10 — see figure 1. Bit 7 is always set and switches on the 3/8 line decoder B. A 3/8 line decoder takes a three-bit binary number and converts it to decimal, that is, zero to seven or eight lines. Bits 6-4 of register 36869 also go to the 3/8 line decoder and decode to the corresponding line depending on how the bits are set.

This then switches on the corresponding RAM which is where the screen will reside. Notice that off-board RAM can be activated by lines 1 to 3; however, you should also notice that the VIC address bus does not extend offboard. To see what happens when you try to put the screen offboard try Poke 36869,144.

You have probably realised that screen RAM can occupy addresses 0-1024 and 4096-8191 which is all the onboard RAM. The first 1K of memory contains all the operating systems variables, interrupt vectors and the stack. Obviously it would not pay to put the screen here. So that leads to the realistic choice of addresses 4096 to 8191. A similar process occurs for access to character. data. If the highest bit of the lower nibble of

Table 1. Screen addresses.

36869	Using ROM characters	36866	648	Screen	Colour RAM
Binary	Dec	Binary	Dec	Start Address	Start Address
1111XXXX	240	1XXXXXXX	30	7680	38400
1111XXXX	240	0XXXXXXX	28	7168	37888
1110XXXX	224	1;XXXXXXX	26	6656	38400
1110XXXX	224	0XXXXXXX	24	6144	37888
1101XXXX	208	1XXXXXXX	22	5632	38400
1101XXXX	208	0XXXXXXX	20	5120	37888
1100XXXX	192	1XXXXXXX	18	4608	38400
1100XXXX	192	0XXXXXXX	16	4096	37888
1101-1101	These are not available				
1000XXXX	128	1XXXXXXX	2	512	38400
1000XXXX	128	0XXXXXXX	0	0	37888

Table 2. Character Addresses.

36869		*Start Addresses*	*ROM or RAM*
XXXX0000	*0*	*32768*	*ROM*
XXXX0001	1	33792	ROM
XXXX0010	2	34816	ROM
XXXX0011	3	35840	ROM
XXXX0100	4	Unavailable	—
XXXX0101	5	Unavailable	—
XXXX0110	6	Unavailable	—
XXXX0111	7	Unavailable	—
XXXX1000	8	0	RAM
1001-1011	9-11	These are off board	RAM
XXXX1100	12	4096	RAM
XXXX1101	13	5120	RAM
XXXX1110	14	6144	RAM
XXXX1111	15	7168	RAM

Figure 2. Control registers 36869 and 36866.

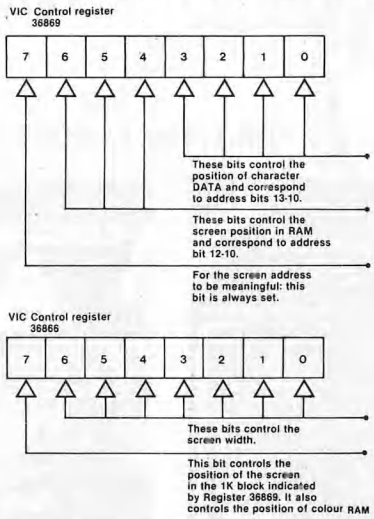
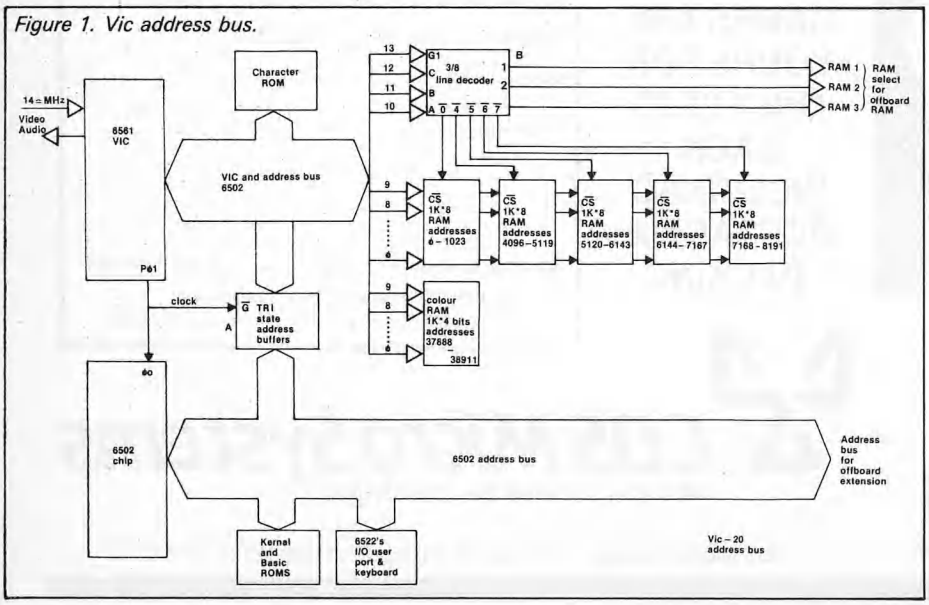


Figure 1. Vic address bus.



VIC-20

Alan Westwood opens up the possibilities of screen display on the versatile Vic-20, then introduces you to the Visual Interface Chip illustrating how to define several screens at once.

TIPLE SCREENS

register 36869 is set, then character data resides in RAM; the rest of the nibble determines where in RAM. If this bit is not set, the character data is in ROM.

Now, to register 36866 — bit 7 is all that concerns us here — this bit determines which half of the 1K block the screen occupies. The normal size screen occupies 506 bytes of memory. If the bit is set, the screen starts at the address indicated by register 36869 plus 512; if the bit is not set, then the screen starts at the address indicated by register 36869. This bit also sets the position of colour RAM. 1-38400 0-37888. If you do your sums you will find that leaves us with eight screen positions between addresses 4096 and 8191. There is one more address you should know and that is 648. This does not affect the screen position, it just tells Basic which page it is in.

This is summarised in tables 1 and 2. Table 1 contains the screen information and table 2 the character information. The Xs indicate that information is not relevant. Note that register 648 indicates page address of screen to Basic.

Now for a few examples. Listing 1 is a machine-code routine which you will find useful. It uses the interrupt — IRQ — to flip screen pages depending on which function key is pressed. As written, it fits into an unexpanded machine, and switches between screen addresses 7168 to 7678 and 7680 to 8185.

Having entered the program and Saved it, run the program. Then, all being well, you can clear out the loader program with New and enter you own program. Provided you do not change the top of memory pointers the routine

(continued on page 119)

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(continued from page 115)
should sit here quite happily. If you have more memory you may like to add more screen pages — if you have more than 8K, you will have to set the start of Basic first. To help, the listing shown in figure 3 is a full dissassembly and description of the program. The code is entirely relocatable so you can put it where you like, but the interrupt vector must be changed accordingly. Because the program uses the interrupt vector, the screens can be flipped at any time, even when running another program.

There are a few problems associated with printing to the screens. For example: at set-up, you cannot print on one screen and then print on the other, without first printing a

clr/home

as Basic can only keep track of one cursor. If you do not need to keep data on the screens use:

POKE648,screen page:PRINT"clr/home"

this resets the cursor position for Basic. But if you do want to keep data on the screen it is easiest to use Pokes. Otherwise you will have to use machine code and add your own bit to the operating system.

Listing 2 is a short program to create a fully expanded screen on an unexpanded Vic. It does this by lowering the screen to address 7168 and then adjusting the control registers accordingly. On most televisions some of the screen will not be visible as they are usually over-adjusted, this being regarded as a "good fault".

The final program, listing 3, is a demonstration of the animation possibilities. I have used some techniques in the program which you may find useful elsewhere so here is a description.

Lines 10-100 set up the character data and a machine-code routine. You should notice that the character data is in the first 1K of memory, the cassette buffer to be precise. This is fine provided you know the space character occupies the bottom of the hardware stack. This area of memory is used by the interpreter to convert floating-point numbers to ASCII for output to the screen — or other device. What this means, in practice, is that you cannot have a numeric output from the program without corrupting the space character.

Line 110 clears the three screens. Lines 115-150 form the main routine. C1, C2 and C3 are character parameters passed to the machine-code routine.

Lines 160-210 perform the animation. All the animation is done in Basic. The machine-code routine is simply to change the characters on the screen fast enough so that you do not have to sit around waiting.

Lines 220-300 contain character and machine-code data; lines 265 is a checksum for the machine code. Line 310 is a one-line hex-to-decimal converter.

Line 320 uses the machine-code routine to change the characters on the screens. The parameters are passed via addresses 0-2 and 782. Address 0 contains the character on the first screen, address 1 contains the character on the second screen, address 2 contains the character on the third screen and 782 passes to the y register the start position on the screen; thus Poke 782,0 puts the start position in the first position on the screen and the routine deposits a character at every sixth position from that.

Lines 1000-plus give a nice finish. ■

Figure 3. the disassembly of listing 1.

```
1BB0  78            :sei          \SET UP INTERRUPT VECTOR
1BB1  A9 BD         :lda#BD       \INTERRUPT ADDRESS <BYTE
1BB3  8D 14 03      :sta314       \
1BB6  A9 1B         :lda#1B       \INTERRUPT ADDRESS >BYTE
1BB8  8D 15 03      :sta315       \
1BBB  58            :cli          \
1BBC  60            :rts          \
1BBD  20 1E EB      :jsrEB1E      \SCNKYBD
1BC0  A4 C6         :ldyC6        \POINTER TO CH IN KYBD BFFR
1BC2  B9 76 02      :lda276,y     \GET CHARACTER
1BC5  C9 85         :cmp#85       \FNKEY1?
1BC7  F0 07         :beqFN1       \YES GOTO FN1
1BC9  C9 86         :cmp#86       \FNKEY3?
1BCB  F0 1A         :beqFN2       \YES GOTO FN2
1BCD  4C BF EA:END:jmpEABF        \GOTO ROM INTTERRUPT HANDLER
1BD0  A9 7F     :FN1:lda#7F       \
1BD2  2D 02 90      :and9002      \MASK OUT BIT 7 OF 36866
1BD5  8D 02 90      :sta9002      \
1BD8  A9 0F         :lda#0F       \KEEP CHRCTR PNTR
1BDA  2D 05 90      :and9005      \
1BDD  09 F0         :ora#F0       \SET SCREEN PNTR
1BDF  8D 05 90      :sta9005      \
1BE2  20 D2 E5:CLB:jsrE5D2        \CLEAR OUT KYBD BFFR
1BE5  90 E6         :bccEND       \FINISHED
1BE7  A9 80     :FN2:lda#80       \
1BE9  0D 02 90      :ora9002      \SET BIT SEVEN OF 36866
1BEC  8D 02 90      :sta9002      \
1BEF  A9 0F         :lda#F        \KEEP CHRCTR PNTR
1BF1  2D 05 90      :and9005      \
1BF4  09 F0         :ora#F0       \SET SCREEN PNTR
1BF6  8D 05 90      :sta9005      \
1BF9  D0 E7         :bneCLB       \FINISHED SO GO CLB
```

Listing 1.

```
5 REM FLIP SCREEN INTERRUPT C.1983 A.WESTWOOD
10 POKE52,27:POKE56,27:POKE51,176:POKE55,176:PRINT"[]■":POKE36879,110:CS=0
20 FORN=0TO100
30 READH$:IFH$="*"THEN70
40 GOSUB190:CS=CS+D
50 POKE7088+N,D
60 NEXT
70 READCT:IFCS<>CTTHENPRINT"CHECKSUM ERROR":STOP
80 SYS7088
90 POKE648,28:PRINT"[]■■■■■■■■■■■■■■■■SCREEN 1■■ADDRESSES 7168 TO 7678"
100 POKE648,30:PRINT"[]■■■■■■■■■■■■■■■■SCREEN 2■■■ADRESSES 7680 TO 8185■"
110 END
115 REM SET UP INTERRUPT VECTOR
120 DATA78,A9,BD,8D,14,3,A9,1B,8D,15,3,58,60
125 REM INTERRUPT ROUTINE TO FLIP SCREENS F1-SCREEN1 F3-SCREEN2
130 DATA20,1E,1B,A4,C6,B9,76,2,C9,85,F0,7,C9,86
140 DATAF0,1A,4C,BF,EA,A9,7F,2D,2,90,8D,2,90,A9,F
150 DATA2D,5,90,9,F0,8D,5,90,20,D2,E5,90,E6,A9,80,D
160 DATA2,90,8D,2,90,A9,F,2D,5,90,9,F0,8D,5,90,D0,E7
170 DATA*
175 REM CHECKSUM
180 DATA8469
190 D=0:IFH$>""THENFORI=1TOLEN(H$):A=ASC(MID$(H$,I))-48:D=D*16+A+(A>9)*7:NEXT:RE
TURN
```

Listing 2.

```
10 REM FULLY EXPANDED SCREEEN ON UNEXPANDED VIC
20 POKE52,28:POKE56,28
30 POKE36864,8:POKE36865,18
40 POKE36866,27:POKE36867,92
50 POKE648,28:PRINT"[]"
```

Listing 3.

```
1 REM DEMO PROGRAM FOR MULTIPLE SCREENS C.1983 A.WESTWOOD
10 S=1:A1=36866:A2=A1+3:MC=6335:CS=0
20 TF=36876:POKETF,0:POKE36878,15
30 POKE52,24:POKE56,24:POKE55,190:POKE51,190
40 POKE36879,138:PRINT"[]■■"
50 PRINT"■■■■■■■■■THE■■■■■■ARMCHAIR■■■■■■EXERCISER"
60 FORJ=0TO62:READH$:GOSUB310:POKEJ+MC,D:CS=CS+D:NEXT:READCT:IFCS<>CTTHENPRINT"C
HECKSUM ERROR":END
70 FORJ=0TO7:POKE256+J,0:NEXT
80 PRINT"■■■■■■FOR■■■■■■TIRED■■■■■■BODIES!!"
90 FORJ=0TO71:READH$:GOSUB310:POKEJ+832,D:NEXT
100 POKEA2,248
110 POKE648,26:PRINT"[]":POKE648,28:PRINT"[]":POKE648,30:PRINT"[]"
115 FORS=0TO200:STEP40
120 C1=106:C2=104:C3=105:GOSUB320:GOSUB160
130 C1=109:C2=107:C3=108:GOSUB320:GOSUB160
140 C1=112:C2=110:C3=111:GOSUB320:GOSUB160
150 NEXTS
152 S=100:POKEA2,248
153 FORI=160TO145STEP-1
154 GOSUB220:POKETF,I
155 NEXTI
156 POKETF,0:POKEA2,232:GOSUB220:POKEA2,248:POKEA1,22
159 GOTO1000
160 FORT=1TO4
170 GOSUB220:POKEA1,150:POKEA2,232:POKETF,220:POKETF,0
180 GOSUB220:POKEA2,248:POKETF,220:POKETF,0
190 GOSUB220:POKEA1,22:POKETF,220:POKETF,0
200 GOSUB220:POKEA1,150
210 NEXTT:RETURN
220 FORDE=0TOS:NEXT:RETURN
225 REM MACHINE CODE ROUTINE
230 DATAA5,0,99,0,1A,A5,1,99,0,1C,A5,2,99,0,1E,98
240 DATA29,7,99,0,94,99,0,96,98,18,69,6,A8,90,E1
250 DATAA5,0,99,0,1B,A5,1,99,0,1D,A5,2,99,0,1F,98
260 DATA29,7,99,0,95,99,0,97,98,18,69,6,A8,90,E1,60
263 REM CHECKSUM
265 DATA5439
269 REM CHARACTER DATA
270 DATA18,DB,3C,18,18,18,A5,42,18,18,3C,DB,18,18,24,66
275 DATA0,18,18,3C,3C,18,18,3C,6,6,2,1E,6,2,2,6
280 DATA0,18,18,C,C,A,2,6,0,0,0,0,7E,7E,12,16
285 DATA0,0,0,0,0,9B,FF,FF,0,0,0,20,40,3B,1F,1F
300 DATA0,0,18,10,10,1B,1F,1F
310 D=0:IFH$>""THENFORI=1TOLEN(H$):A=ASC(MID$(H$,I))-48:D=D*16+A+(A>9)*7:NEXT:RE
TURN
320 POKE0,C1:POKE1,C2:POKE2,C3:POKE782,0:SYSMC:POKE782,3:SYSMC
330 RETURN
1000 FORDE=0TO1000:NEXT
1010 FORI=46TO0STEP-2:POKEA1+1,I:POKEA1,I/2+128
1020 PRINT"[]"
1030 FORI=2TO46STEP2:POKEA1+1,I:POKEA1,I/2+127:NEXT
1040 POKEA2,240
```

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SNAKE

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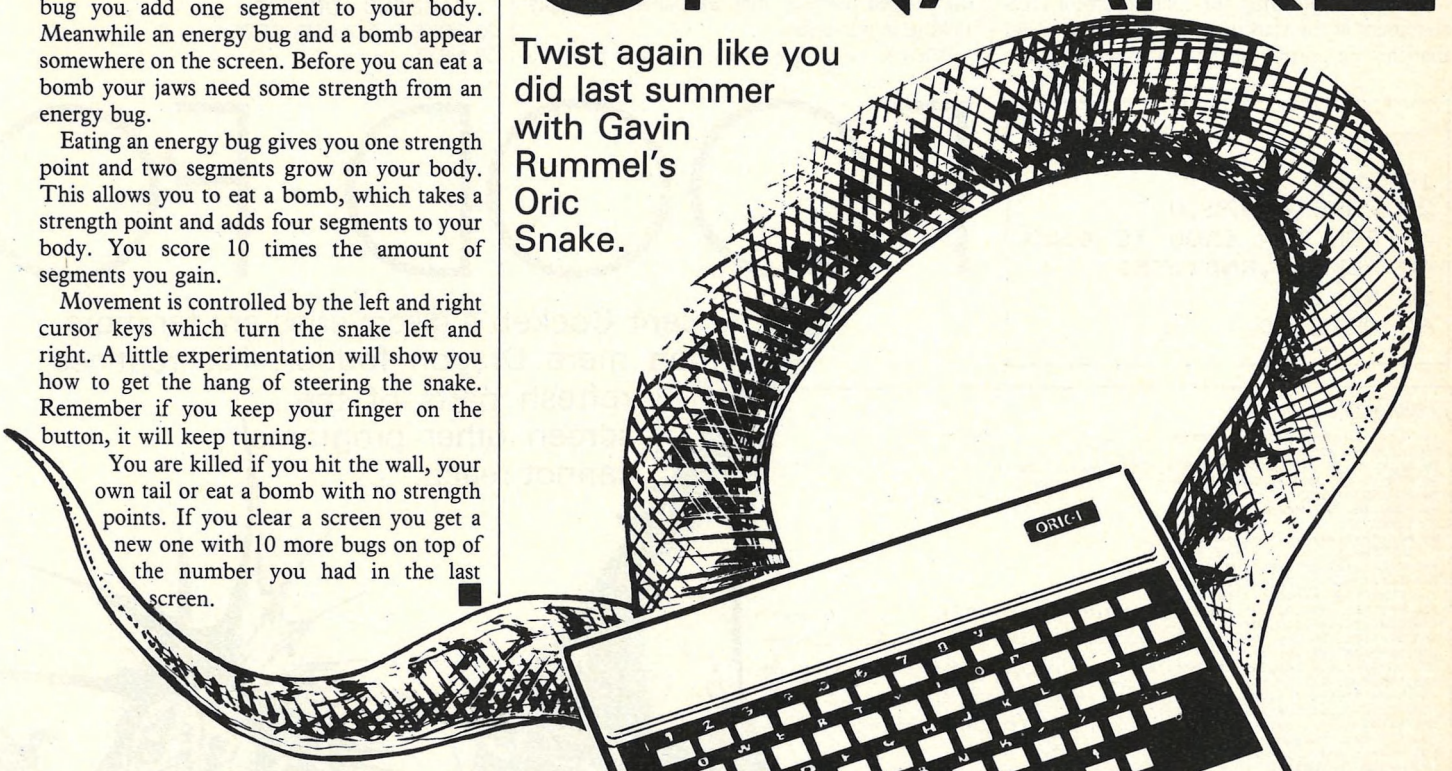
THIS SNAKE game was written on a 16K ZX-81 in July last year with 3K to spare, so it should fit in the 16K Oric if the Grab command is used.

The object is to move the snake round the screen eating bugs, energy bugs and bombs to make the snake longer. You start with a single segment to your body and 10 bugs in random positions on the screen. Every time you eat a bug you add one segment to your body. Meanwhile an energy bug and a bomb appear somewhere on the screen. Before you can eat a bomb your jaws need some strength from an energy bug.

Eating an energy bug gives you one strength point and two segments grow on your body. This allows you to eat a bomb, which takes a strength point and adds four segments to your body. You score 10 times the amount of segments you gain.

Movement is controlled by the left and right cursor keys which turn the snake left and right. A little experimentation will show you how to get the hang of steering the snake. Remember if you keep your finger on the button, it will keep turning.

You are killed if you hit the wall, your own tail or eat a bomb with no strength points. If you clear a screen you get a new one with 10 more bugs on top of the number you had in the last screen. ■




```
3 S=0
6 PRINTCHR$(17);CHR$(20);CHR$(6)
10 DIMA1(37,25)
20 DIMB1(37,25)
28 S=0
29 J=0
30 X=17:Y=12
31 A=X:B=Y
32 X1=0:Y1=0
33 CLS
36 J=J+10
37 F=S
38 RESTORE
40 INK1
41 MUSIC3,1,12,0
42 PLAY4,0,1,10000
50 PAPER0
60 PLOT1,0,20
70 FORZ=1TO25
80 PLOT1,Z,147:PLOT38,Z,128
90 NEXT
100 PLOT1,26,20
130 GOSUB1000
140 FORZ=1TOJ
150 Q=RND(1)*34+3:W=RND(1)*23+2
160 IFSCRN(Q,W)<>32THENGOTO150
170 PLOTQ,W,"\"
180 NEXT
190 E=0
200 DI=3
210 Q=S
220 PLOT2,0,"SCORE:":PLOT8,0,
    STR$(S)
225 PLOT22,0,1
230 PLOT23,0,"HI-SCORE:":
    PLOT33,0,STR$(H)
240 PLOT2,26,"STRENGTH:":
    PLOT10,26,STR$(E)
300 A1(X,Y)=X1
310 B1(X,Y)=Y1
320 X=X+X1
330 Y=Y+Y1
331 IFX<2ORX>37ORY<1ORY>25THENGOTO10000
332 AS=SCRN(X,Y)
340 IFAS=32THENGOTO400
350 IFAS=91THENGOTO10000
360 IFAS=94ANDE=0THENGOTO10000
365 Q=S
370 IFAS=92THENGOTO2000
380 IFAS=94THENGOTO2200
390 IFAS=93THENGOTO2300
395 IFS-F=J*70THENGOTO30
400 PLOTX,Y,"["
401 Q=Q+10
420 IFQ<=STHENGOTO500
430 C=A1(A,B)
440 B=B+B1(A,B)
450 A=A+C
460 PLOTA,B," "
500 X$=KEY$
505 IFX$=""THENGOTO300
510 IFASC(X$)=8ORASC(X$)=9THENGOTO511ELSEGOTO300
511 DI=DI+(ASC(X$)=8)-(ASC(X$)=9)
520 IFDI>3THENDI=0
530 IFDI<0THENDI=3
540 X1=0:Y1=0
550 X1=X1+(DI=2)-(DI=0)
560 Y1=Y1+(DI=3)-(DI=1)
580 GOTO300
1000 FORZ=46808TO46839
1010 READZ1
1020 POKEZ,Z1
1030 NEXT
1040 DATA12,26,57,63,63,63,30,12
1050 DATA33,18,12,45,63,12,63,33
1060 DATA30,45,63,12,30,63,63,45
1070 DATA8,28,28,28,62,62,42,42
1080 RETURN
2000 S=S+10
2001 MUSIC1,6,6,0
2002 PLAY1,0,1,1000
2010 PLOT8,0,STR$(S)
2020 FORG=1TO2
2030 L=RND(1)*34+3
2040 LL=RND(1)*23+2
2050 IFSCRN(L,LL)<>32THENGOTO2030
2060 IFG=1THENPLOTL,LL,"]"ELSEPLOTL,LL,"^"
2070 NEXT
2100 GOTO395
2200 S=S+40
2201 MUSIC2,4,6,0
2202 PLAY2,0,1,1000
2210 PLOT8,0,STR$(S)
2220 E=E-1
2225 E$=STR$(E)+"   "
2230 PLOT10,26,E$
2240 GOTO395
2300 S=S+20
2301 MUSIC3,2,6,0
2302 PLAY4,0,1,1000
2310 PLOT8,0,STR$(S)
2320 E=E+1
2325 E$=STR$(E)+"   "
2330 PLOT10,26,E$
2340 GOTO395
10000 EXPLODE
10100 C=B1(A,B)
10110 A=A+A1(A,B)
10120 B=B+C
10130 IFSCRN(A,B)<>91THENGOTO10240
10140 PLOTA,B," "
10150 GOTO10100
10240 PLOT8,11,10
10245 PLOT8,12,10
10246 PLOT21,11,STR$(S):PLOT21,12,STR$(S)
10250 PLOT16,11,"SCORE:"
10260 PLOT16,12,"SCORE:"
10261 IFS>HTHENPLOT9,11,"NEW HI-":PLOT9,12,"NEW HI-"
10262 IFS>HTHENPLOT26,11,"!!!!!!":PLOT26,12,"!!!!!!"
10265 IFS>HTHENH=S
10270 PLOT14,14,"Another go?"
10280 GETA$
10290 IFA$="y"THENGOTO28
10300 IFA$="n"THENPRINTCHR$(17);CHR$(20);CHR$(6):CLS:
  INKO:PAPER2:ST
OP
10310 GOTO10280
```

FOOD FO

Vincent Cockett's discoveries are far more than mere Dragon fodder. His routines refresh parts of the screen other programs cannot reach.

IN AN EFFORT to try to overcome the restriction in the use of colour in the high-resolution modes, I discovered some useful locations within the Dragon memory that when Poked go a long way to unleash the power of this micro.

Program 1 produced strange results in the first place. However, it was obvious that a full colour set was randomly being displayed on the screen. Following the inclusion of a CLS statement at the start of the program I noticed that the top portion of the screen was cleared. This indicated, therefore, that what was being displayed was the Dragon's text-page memory followed by a portion of the high-resolution pages. From this stage it was reasonably straightforward using a short routine to determine exactly what was being displayed.

The next step was to Poke at locations either side of my original position. The results were equally dramatic and in table 2 I have listed the revised memory map available by simply Poking at a location.

What we now have available to us is not only the Dragon text and memory pages but also three additional text-type pages plus four text-and-graphic pages.

In order to make use of these new pages, you will need to clear the pages to the selected background colour. The PCLS command is of little use and so the only way with Basic to clear the screen is with a short routine:

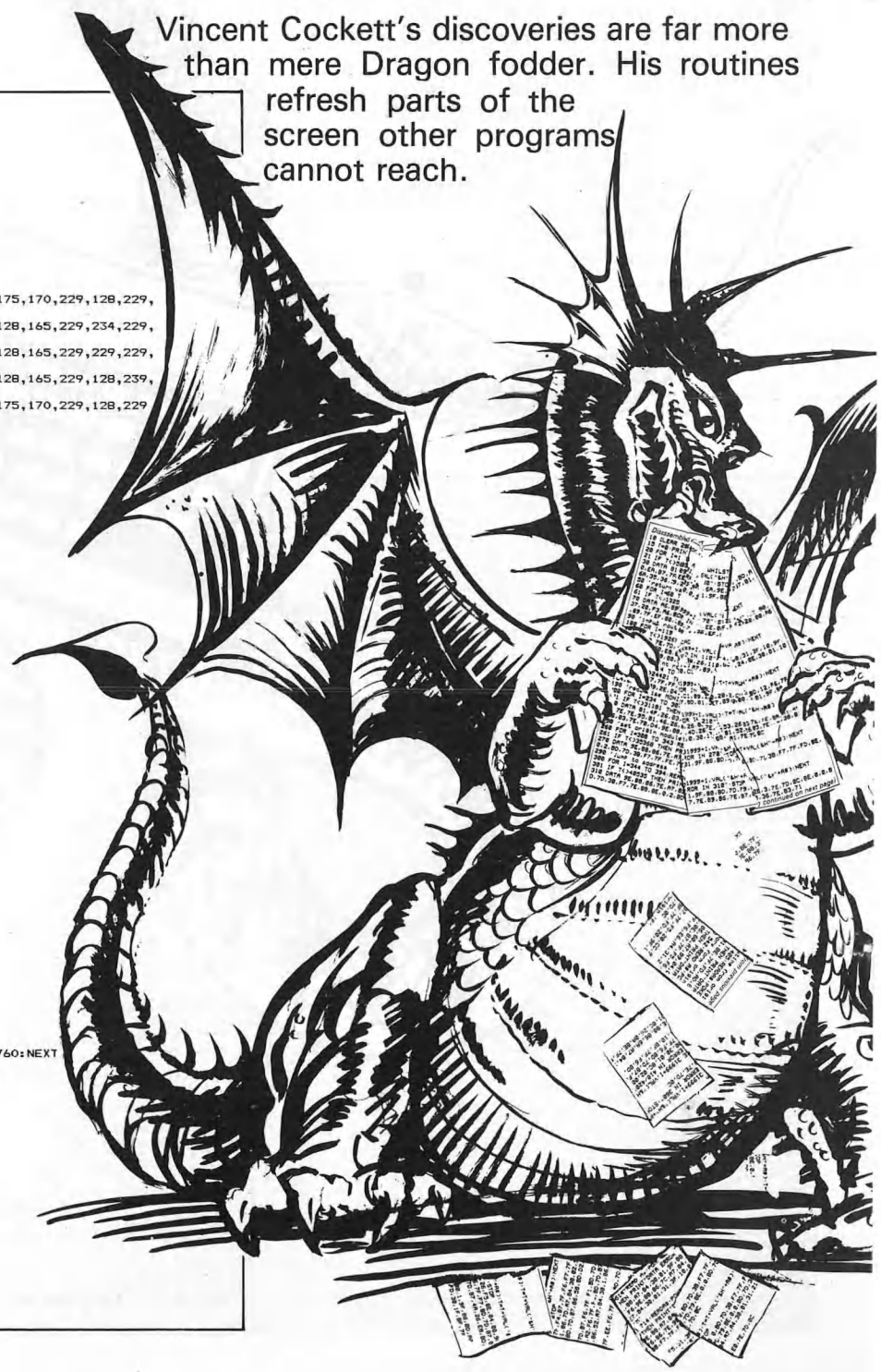
```
10 FOR T = PAGE START ADDRESS TO
   PAGE END ADDRESS
20 POKE T, COLOUR CODE
30 NEXT
```

Program 1.

```
10 CLS
20 POKE 65475,0
30 FOR T = 1500 TO 4000
40 POKE T,RND(255)
50 NEXT
60 GOTO 60
```

Program 3.

```
10 REM****M/CODE SCREEN CLEAR*****
20 CLEAR100,32700:S=32700
30 DATA182,127,255,142,4,0,167,128,140,28,0,38,249,57
40 FORT=0TO13:READX:POKES+T,X:NEXT
50 POKE32767,128
60 POKE114,25:POKE65281,50
70 EXEC32700
80 REM*************************
90 SCREEN0,1
100 POKE65477,0:POKE65495,0
110 DATA128,255,128,143,255
120 FORT=1TO5:READA(T):NEXT
130 DATA181,191,186,245,255,250,128,159,154,128,143,138,128,175,170,229,128,229,
128,128,191,186,128,191
140 DATA181,128,181,245,128,245,149,128,149,133,128,128,165,128,165,229,234,229,
128,128,128,186,181,128
150 DATA181,128,181,245,255,250,149,159,159,133,128,143,165,128,165,229,229,229,
128,128,128,191,191,191
160 DATA181,128,181,245,128,250,149,128,149,133,128,133,165,128,165,229,128,239,
128,128,128,181,128,181
170 DATA181,191,186,245,128,245,149,128,149,128,143,138,128,175,170,229,128,229
128,128,128,128,128,128
180 REM****WRITE 'DRAGON'*******
190 P=1059:GOSUB730
200 P=1091:GOSUB730
210 P=1123:GOSUB730
220 P=1155:GOSUB730
230 P=1187:GOSUB730
240 FORT=1251TO1269:POKET,207:NEXT
250 FORT=1282TO1302:POKET,159:NEXT
260 FORT=1313TO1335:POKET,255:NEXT
270 C=143
280 FORT=1TO8
290 GOSUB850:NEXT
300 REM****DRAW BOX************
310 FORT=0TO9:POKE1524+T,207:POKE2484+T,207:NEXT
320 FORT=0TO30:POKE1523+(T*32),197:POKE1534+(T*32),202:NEXT
330 REM****CHOOSE ACTION********
340 B=B+1
350 IFB=10 THENPOKE65475,0:Z=1
360 C=RND(4):ONC GOTO370,430,570,680
370 REM****KALEIDOSCOPE*********
380 TIMER=0
390 X=RND(10):Y=RND(29)
400 C=(RND(8)*16)+127
410 POKE1523+X+(32*Y),C:SOUNDC,1
420 IFTIMER>=500 THEN GOTO 340 ELSE390
430 REM****BAR GRAPH************
440 FORT=2464TO2478:POKET,207:NEXT
450 FORT=0TO7:A=RND(30):SOUNDA*8,1
460 FORT2=0TO3:POKE2688+(T*2)-(T2*32),T+49:NEXTT2
470 FORT1=2432+(T*2)TO(2432+(T*2)-(A*32)) STEP-32
480 POKET1,143+(16*T)
490 NEXTT1
500 NEXTT
510 FORT=1408TO2432 STEP32
520 FORT1=0TO15
530 POKET+T1,128
540 NEXTT1,T
550 FORD=1TO1000:NEXTD
560 GOTO340
570 REM****SPACE SCEEN*********
580 FORT=0TO31:POKE2752+T,170:NEXT
590 POKE2950,197:POKE3330,197:POKE3702,197:POKE3888,197
600 POKE3288,197:POKE2890,197:POKE3456,197:POKE3878,197
610 FORR=1TO26
620 FORT=1TO2:S=A(T):GOSUB750:NEXT
630 FORT=3TO5:S=A(T):GOSUB760:NEXT
640 FORD=1TO50:NEXT
650 IFR=26 THENFORT=1TO2:S=128:GOSUB750:NEXT:FORT=3TO5:GOSUB760:NEXT
660 NEXT
670 GOTO340
680 REM****PRINT ROUTINE********
690 A$="EUREKA!":GOSUB770
700 FORD=1TO200:NEXTD
710 A$="":FORT=1TO7:A$=A$+CHR$(128):NEXT:GOSUB770
720 GOTO340
730 FORT=1TO24:READA:POKEP,A:P=P+1:NEXT
740 RETURN
750 POKE3453+R+T,S:RETURN
760 POKE3483+R+T,S:RETURN
770 FORT=1TOLEN(A$)
780 A=ABS(ASC(MID$(A$,T,1)))
790 IFA=128 THENB10
800 IFA>63 THENA=A-64
810 FORT2=(-160*Z)TO160 STEP32
820 POKE1956+T-T2,A
830 NEXTT2,T
840 RETURN
850 FORT1=0TO15:POKE3936+W,C:W=W+1:NEXT:C=C+16:RETURN
```



The code number is the same as shown in the graphics section of the Dragon manual. As a point of interest, if the routine

```
10 PCLS1:CLS8
```

is used the screen will clear to orange.

By far the quickest way of clearing the screen is to use machine-code routines. In the demonstration program I have included an example of screen clearance for the higher resolution. So that it can be in different resolutions or on the additional text pages I have listed the changes to the Data statements in table 1.

Now to try and explain what is happening to your computer. It would seem that by accessing these locations the computer is not aware that it is only in Text mode when it is summoned to display the high-resolution screen.

Consequently it leaves all the standard character set still available to the user.

Of first importance to the user is the retention of the black border. By clearing to a black background you finish with a totally black picture.

The next stage in the development of a usable program produced some more interesting results. The task was to produce a bar chart using a reasonable degree of resolution. As you can see from table 2, the three locations give different results of resolution.

It does not appear to matter what value is Poked to the memory location. The fact that the address has been accessed is the only requirement. So far I have only discussed using the code for the full-colour block. The next step in development was to use the codes for the half-blocks vertically split. To my delight, the bar chart was produced with half the original width and so had a much neater appearance.

Things were now looking very promising so I then used codes for the letters in place of the colour codes and as the bar chart unfolded, slice by slice, the letters were built up to form the bar.

Now all was becoming clear. What the computer was doing was reproducing only slices of each graphic or letter and only the amount according to the resolution set.

It is not possible to print on the new text pages or the extended higher-resolution pages. However, with a short routine — program 2 — it is possible to enter any text or graphic blocks in string formation and Poke them to the screen. With the routine it is also possible to select normal or reversed letters in a choice of green or orange. The demonstration program — program 3 — contains an example of printing with graphic blocks when the 128 code for the black block is used to clear Eureka! from the screen.

The only restriction on writing to the screen is that to obtain the full character the normal Print location has to be used. Try to alter the Print position in the demonstration program by increasing or decreasing the Print line in multiples of 32.

If you feel like you want to experiment you may like to try and add sections of various letters together to make new graphic shapes.

Multicoloured games can now be played with scenery and characers built from colour slices.

I am now left with one problem. What can be done with location 65473? If you try program 3 you will see that the screen is split in half down the middle. The resulting picture is duplicated on both halves of the display.

In the demonstration program do not enter line 60 until the program is finalised. It is safer to tape you program before entering this line, or else you may lose the lot.

Poke 114,25 prevents the reset button being used to stop the program by restarting the computer as if it had just been switched on, and Poke 65281,50 disables the keyboard. ■

R THE DRAGON

Program 2.

```
10 SCREENO,1:REM***SET PAGE COLOUR***USE SCREENO,O FOR GREEN****
20 CLSO
30 POKE65475,O
40 REM****PA=PRINT@,************
50 PA=0:A$="DRAGON WRITER FOR USE ON THE":GOSUB150
60 PA=64:A$="STANDARD OR EXTENDED DRAGON":GOSUB150
70 PA=160:A$="SCREEN.YOU HAVE A CHOICE OF TEXT":GOSUB150
80 PA=224:A$="AND ALL KEYBOARD CHARACTERS IN":GOSUB150
90 PA=288:A$="NORMAL OR REVERSE FIELD IN YOUR":GOSUB150
100 PA=352:A$="CHOICE OF ORANGE OR GREEN":GOSUB150
110 PA=448:A$="!£$%&'()*=1234567890:-,./;<>?+":GOSUB150
120 GOTO120
130 REM
140 REM
150 REM------PRINT ROUTINE------
160 REM
170 FORT=1TOLEN(A$)
180 A=ABS(ASC(MID$(A$,T,1)))
190 IFA>63 THENA=A-64:REM***THIS GIVES REVERSE FIELD LETTERS****TO GIVE NORMAL W
RITING CHANGE TO****IFA<64 THENA=A+64**********
200 FORT2=OTO(32*3) STEP32
210 POKE(1023+(32*3))+(4*PA)+T-T2,A
220 REM****1023 IS PAGE (START ADDRESS - 1). CHANGE ACCORDING TO PAGE IN USE****
****************
230 NEXTT2
240 NEXTT
250 RETURN
260 REM
270 REM
280 REM**FOR THE HIGHER RESOLUTION PAGE CHANGE LINE 30 TO POKE65477:IN LINES 200
 & 210 3=5 AND 4=6**SIMILARLY FOR HIGHER RES.ADOPT ACCORDINGLY*****************
290 REM
300 REM**FOR NORMAL OR ADDITIONAL TEXT PAGES DELETE LINES 200 AND 230 **********
****************
```

Table 1.

Resolution Set	Screen clearance data
65475 and 65477	182, 127, 255, 142, 4, 0, 167, 128, 140, 28, 0, 38, 249, 57
65473	182, 127, 255, 142, 4, 0, 167, 128, 140, 16, 0, 38, 249, 57
65477	182, 127, 255, 142, 4, 0, 167, 128, 140, 16, 0, 38, 249, 57
65475	132, 127, 255, 142, 4, 0, 167, 128, 140, 12, 0, 38, 249, 57
65483	182, 127, 255, 142, 12, 0, 167, 128, 140, 13, 255, 38, 249, 57
65485	182, 127, 255, 142, 20, 0, 167, 128, 140, 21, 255, 38, 249, 57

The character code for the screen colour to be set should be Poked into location 32767 — that is, Poke 32767,255 sets the screen to orange.

Table 2. Text and graphics.

Memory location	65473	65475	65477	65475 and 65477
Screen address	1024-4096	1024-3072	1024-4096	1024-7168
Screen width	32*2	32	32	32
Screen height	96*2	64	96	192
Text pages				
Memory location	65479	65483	65485	
Screen address	1536-2047	3072-3583	5120-5631	

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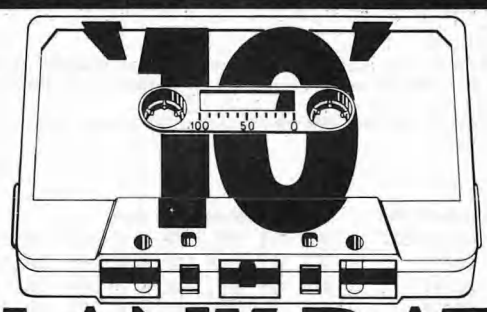

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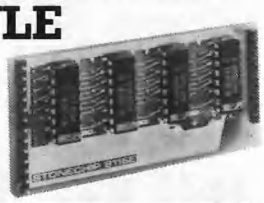

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BBC PIXEL PLOTTER

Chunky pixels and coloured backgrounds: Chris Melville presents some mode 7 ideas to chew over.

MODE 7 provides a full eight colours although at first sight its graphic capabilities may seem a little limited. However, it does have a character set which includes block graphic characters. Sensible use of these can help to realise pseudo low-resolution graphics such as the use of "chunky" pixels for plotting and drawing figures. Also, we can make use of the windowing capabilities of the BBC — which still exist in mode 7 — to emulate foregound and background colouring done permanently in other modes with VDU19,Colour and Gcol,so that Ctrl L,CLS and scrolling do not change the colour scheme.

In order to produce a coloured character on a mode 7 screen we must precede it with one of the graphic control codes somewhere along the line. Suppose then, that we wanted to have a foreground colour of yellow and background colour of blue over the whole screen. It is easily done by writing the necessary control characters; these are 132, 157, 134 for Alpha-blue, Background, Alpha-cyan respectively to the first three character positions on every line.

This still has two drawbacks. First, as soon as the screen scrolls or you print on a new line, list the program or clear the screen the effect will be lost and you will have to re-write all the control characters again. We can stop this from happening by creating a text window which envelopes the whole screen apart from the left-most three columns. Thus both you and the machine are prevented from interfering with the control codes that have been placed in these columns, unless you change mode or re-define the window.

Second, three character positions on each line are lost. This cannot be prevented, although use of the window will insure that statements such as

PRINT TAB(0,2)

print at the apparent beginning of line and not over the control codes.

Of course, there is no reason why different sections cannot have different foreground and background colours, it just depends on the control codes — you could have half the screen in double-height flashing graphics, red if required. Listing 1 shows the code which will do the job in the form of a procedure. The parameters to be given to the procedure are, in order: Procscreencoll, start line number, finish line number, foreground colour and background colour.

It is necessary that Procinit1 gets called once before Procscreencoll is ever used since this defines the colour names, amongst other things. This means that you can refer to the colour using names. Prefix the name of the colour in lower case with either G for choosing a graphics colour-foreground only or A for an alphanumeric colour: and use it in the procedure call.

The one exception is black which is referred to as "dark" and can only be used as a background parameter. The action of the procedure is very simple: it checks the parameters and exits without doing anything if erroneous; cancels out any existing window; puts the correct control codes in the correct place; and re-defines the text window as required. The procedure is in Basic and therefore not very useful as part of, say, a games program using continuous foreground/background colour changing since one can see the colour changing "flowing" down the screen. A much faster assembly language version is provided, which also serves as a good example of operating system calls. This time the parameters are passed as follows.

There are four bytes in memory named y-start,y-end, frontcol, backcol — names are defined in the initialising procedure. These should be set up as required before the subroutine is called.

Procinit2 must be called once only as before — see listing 2. The actual routine is now

(continued on page 129)

Listing 1.

```
   10 REM demo program
   20 PROCinit1
   30 PROCscreencol(0,6,Acyan,Ablue)
   40 PROCscreencol(7,15,Ayellow,Ared)
   50 PROCscreencol(16,21,Awhite,Amagenta)
   60 PROCscreencol(22,24,Agreen,Awhite)
   80 REM now print to the screen.
   90 CLS:ON ERROR  LIST:END
  100 ERROR
  110
  120
  130
 1000REM THE FOLLOWING PROCEDURES ARE USED TO COLOUR A TELETEXT SCREEN SO THAT T
HE COLOUR IS NOT REMOVED BY CLS,SCROLLING,PRINTING ETC.
 1010
 1020
 1030REM  The first procedure is an initialising one and should be called once o
nly,preferably right at the beginning of any program which uses the PROCscreenco
l procedure.
 1040
 1050
 1060
 1070DEF PROCinit1
 1080
 1090Ared=129:Agreen=130:Ayellow=131
 1100Ablue=132:Amagenta=133:Acyan=134
 1110Awhite=135
 1120
 1130REM ** and now the graphics colours **
 1140Gred=145:Ggreen=146:Gyellow=147
 1150Gblue=148:Gmagenta=149:Gcyan=150
 1160Gwhite=151:dark=156
 1170
 1180ENDPROC
 1190
 1200
 1210
 1220
 1230REM ** The following procedure colours  "permanently" a section of the scre
en,the boundering y-values being the first two parameters.The foreground (may be
 a text colour or a graphic one) and backround (text colour only) colours follow
.
 1240
 1250
 1260
 1270DEF PROCscreencol(y_start%,y_end%,frontcol%,backcol%)
 1280LOCAL i%
 1290
 1300REM First check that parameters are legal.
 1310
 1320IF FNnotin(y_start%,0,24) OR FNnotin(y_end%,y_start%,24) THEN ENDPROC
 1330IF FNnotin(frontcol%,129,135) AND FNnotin(frontcol%,145,151) THEN ENDPROC
 1340IF FNnotin(backcol%,129,135) AND backcol% <> dark THEN ENDPROC
 1350
 1360REM First restore text window to full size.
 1370VDU 26
 1390REM Now insert colour control characters down left-hand side of screen.
 1391IF backcol%=dark THEN first%=160:second%=dark ELSE first%=backcol%:second%=
157
 1400FOR i%=y_start% TO y_end%
 1410  VDU 31,0,i%,first%,second%,frontcol%
 1420NEXT i%
 1440REM Now set up text window to exclude leftmost three columns-thus protectin
g the colour codes.
 1450VDU28,3,24,39,0
 1470ENDPROC
 1500REM The following function must appear since it is used by the above proced
ure to check for erroneous values.
 1520DEF FNnotin(x%,x_low%,x_high%)
 1530IF x%<x_low% OR x%>x_high% THEN = TRUE ELSE = FALSE
```

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Listing 2.

```
   10 CALL screencol2
   20END
   30REM The follwoing procedure initialises PROCscreencol2 by defining BASIC co
nstants,reserving memory for m.c. variables and causing the assembly of the code
.It should de called once,at the beginning of any program which will JSR screenc
ol2
   40
   50DEF PROCinit2
   60 Ared=129:Agreen=130:Ayellow=131:Ablue=132:Amagenta=133:Acyan=134:Awhite=13
5
   70 Gred=145:Ggreen=146:Gyellow=147:Gblue=148:Gmagenta=149:Gcyan=150:Gwhite=15
1:dark=156
   80DIM y_start 0,y_end 0,frontcol 0,backcol 0,tmp 0
   90OSWRCH=!&20E AND &FFFF
  100
  110 REM NOW ASSEMBLE CODE:
  120DIM space 200
  130 FOR pass%=0 TO 2 STEP 2
  140 P%=space
  150PROCscreencol2
  160NEXT
  170ENDPROC
  180
  190
  200
  210DEF PROCscreencol2
  220[ OPT pass%
  230
  240.screencol2
  250       PHA:TXA:PHA:TYA:PHA \SAVE REGISTERS
  260       LDA y_start
  270       LDX £0
  280       LDY £24
  290       JSR notin
  300       BCS scret1
  310       LDA y_end
  320       LDX y_start
  330       JSR notin
  340       BCS scret1
  350       LDA frontcol
  360       LDX £129
  370       LDY £135
  380       JSR notin
  390       BCC skp12
  400       LDX £145
  410       LDY £151
  420       JSR notin
  430       BCS scret1
  440.skp12 LDA backcol
  450       CMP £dark
  460       BEQ skp22
  470       LDX £129
  480       LDY £135
  490       JSR notin
  500       BCS scret1
  510
  520\ At this stage the parameters are OK so the job can begin.
  530.skp22 LDA £26       \Reset text window
  540       JSR OSWRCH
  550
  560       LDX y_start   \Initialise count
  570.lp11  LDA £31       \Do a tab
  580       JSR OSWRCH
  590       LDA £0        \To x=0
  600       JSR OSWRCH
  610       TXA           \y=index value
  620       JSR OSWRCH
  630
  640       LDA backcol   \Now put down backround
  650       JSR OSWRCH    \control character.
  660       LDA £157
  670       JSR OSWRCH
  680       LDA frontcol  \And then foreground.
  690       JSR OSWRCH
  700       INX           \Increment count.
  710       CPX y_end     \Count finished??
  720       BCC lp11
  730       BEQ lp11
  740\Now the text window is set to exclude the deposited control characters.
  750       LDA £28
  760       JSR OSWRCH
  770       LDA £3
  780       JSR OSWRCH
  790       LDA £24
  800       JSR OSWRCH
  810       LDA £39
  820       JSR OSWRCH
  830       LDA £0
  840       JSR OSWRCH
  850       JMP scret2
  860\Come here if parameters faulty
  870.scret1 LDA £7  \do a beep
  880          JSR OSWRCH
  890\Now restore registers and return from subroutine.
  900.scret2 PLA:TAY:PLA:TAX:PLA
  910          RTS
  920\The following subroutine is called during the checking stage of the above.
  930\It returns 'Carry set' if the contents of A lies outside the range given b
y X and Y
  940.notin STA tmp
  950       CPX tmp
  960       BEQ nt1
  970       BCS ntr
  980.nt1   CPY tmp
  990       BCC ntr
 1000       CLC:RTS
 1010.ntr   SEC:RTS
 1020
 1030]
 1040ENDPROC
```

(continued from page 127)

called by:

CALL screencol2

from Basic or

JSR screencol2

from assembly. Try the following demo program:

```
1 PROCinit2:FOR I% = 0 TO 4
2 READ S%,E%,F%,B%
3 ?y_start = S%:?y-end = E%:?frontcol =
  F%:?backcol = B%
4 CALL screencol2
5 NEXT I%
6 DATA 0,5,Acyan,Ablue,6,11,Ablue,Ayellow,
  12,17,Gmagenta,Awhite,18,21,Ayellow,
  Ared,22,24,Agreen,dark
7 END
```

Now list the program and try and read it. Some colour combinations more easy on the eye include: cyan and blue; yellow and blue; magenta and white; yellow and red and green and white.

In mode 7 we have 40 characters across the screen and 25 down it. We also have graphics shapes, each the size of a character, which are split into squares of which there are two across and three up. This gives an effective screen resolution of 80 across and 75 up which, although small by comparison to other modes, is sufficient for bat-and-ball-type games and static displays as used by Ceefax. Suppose we say the x axis goes from 0 to 79 and the 7 axis from 0 to 74 — relative to botton left-hand side of screen — and we wish to plot the pixel with co-ordinates (x,y)

Work out which character square the pixel lies in. This is given by:

c.p. = (xDIV2,24–yDIV3)

Make a note of the ASCII code of any

(continued on next page)

Listing 3.

```
   5REM FOR £ READ HASH CHARACTER
   10REM A DEMONSTRATION:
   20PROCinit3
   30CLS:FORQ=0TO25:PRINT'CHR$(145+Q MOD7);:NEXT:VDU28,1,24,39,0,23,1,0;0;0;
   40REPEAT
   50   CX%=RND(60):CY%=RND(60):RX%=RND(50):AX%=1
   60   FOR ZX=0 TO 360 STEP 2
   70        X%=CX%+RX%*COSRADZ%
   80        Y%=CY%+RX%*SINRADZ%
   90        CALL pix
  100   NEXT
  110UNTIL FALSE
  120END
  130
  140
  150
  160REM The following procedure initialises things for the
  170REM pix subroutine by defining constants,reserving RAMspace
  180REM and assembling the code.
  190
  200
  210DEF PROCinit3
  220
  230oswrch=&FFEE : osbyte=&FFF4
  240
  250DIM tx 0,ty 0,ta 0,tmp1 0,tmp2 0,table 7,space 150,char 0
  260
  270REM The following sets up a look-up table to be used when
  280REM deciding which graphics character is needed to fill
  290REM up a particular pixel on the screen.
  300!table=&0B040201 : table!4=&4010
  310
  320REM now assemble the code
  330FOR pass=0 TO 2 STEP 2
  340P%=space
  350PROCpixcode
  360NEXT
  370
  380ENDPROC
  390
  400
  410
  420
  430REM The following procedure is alled in assembly language
  440REM bu "JSR pix" and the pixel whose x coordinate is
  450REM stored in the x register (0-79) and whose y coordinate is
  460REM stored in the y register (0-74) will be plotted/unplotted
  470REM according to the value of the accumulator (0=unplot,1=plot)
  480
  490DEF PROCpixcode
  500[OPT pass
  510.pix   STA ta        \Save register contents.
  520       STX tx
  530       STY ty
  540
  550       CPX £79       \Check parameters
  560       BCS pxout
  570       CPY £75
  580       BCS pxout
  590       LDA £31       \Prepare OS for a TAB
  600       JSR oswrch
  610
  620 \We now work out the tab positions of the character square
  630 \in which the required pixel is contained.The tab positions are related to
the
  640 \pixel positions by:
  650 \tab(x)=xDIV2
  660\tab(y)=24-yDIV3
  670
  680       TXA           \Work out tab(x)
  690       CLC:ROR A     \ DIV2
  700       JSR oswrch    \Move to this x tab position.
  710
  720\We now need to work out yDIV3 and yMOD3
  730       LDX £0        \x reg used for count
  740       TYA           \put y value in accumulator
  750.loop  CMP £3        \has y been reduced to <3
  760       BCC exit      \if so,leave subtraction loop
  770       INX           \increment count
  780       SBC £3        \subtract another 3
  790       JMP loop      \continue process.
  800
  810\at this stage yDIV3 is in x reg and yMOD3 is in accumulator.
  820
  830.exit STX tmp1       \save yDIV3
  840       STa tmp2      \save yMOD3
  850
  860       LDA £24       \now work out y tab position
  870       SEC : SBC tmp1
  880       JSR oswrch    \complete tab positioning.
  890
  900\we now use the values of xMOD2 and yMOD3 to determine
  910\which graphics character we want.The result is an index
  920\pointing into the look-up table at table.
  930       LDA tx
  940       AND £1        \Reduce mod2
  950       CLC:ADC £4    \Now work out table pointer
  960       SEC:SBC tmp2
  970       SEC:SBC tmp2
  980       TAX
  990       LDA table,X \get table element
 1000       STA tmp1
 1010       LDA £135
 1020       JSR osbyte    \this returns the code of any
 1030       TXA:STA char \character already on the screen here.
 1040       LDX ta        \Is new pixel to be set or reset.
 1050       BNE stpx      \if set,skip next bit.
 1060       STA tmp2      \save char just read from screen
 1070       LDA £0        \invert the table element
 1080       CLC:SBC tmp1 \as it is used now to mask off the bit
 1090       AND tmp2      \which turns on our specified pixel.
 1100       JMP stbt      \Continue with routine.
 1110.stpx  ORA tmp1      \to set pixel,OR it into the character code.
 1120.stbt  ORA £128      \and set leftmost bit.
 1130       JSR oswrch    \print it onto screen.
 1140.pxout LDA ta        \Restore registers
 1150       LDX tx
 1160       LDY ty
 1170       RTS
 1180]:ENDPROC
```

(continued from previous page)

character that is already inside this character square. Some of the available pixels within this square may already be filled and of course they must remain filled when we choose the new graphic character.

Work out the displacement of the pixel within the calculated character square

DISP(X) = xmod2, DISP(y) = ymod3

and decide which of the teletext graphics characters — see back of manual — fills only this pixel.

This can be done using a predefined look-up table in the form of an array containing the relevant ASCII codes.

Now determine, by means of a logical Or, the ASCII code of the character which fills up both the selected pixel and those that were originally filled.

Print the selected character at the Tab position that you first calculated.

I have provided an assembly language subroutine — see listing 3 — which performs these steps for you. It can be used from either Basic by

CALL pix

or assembler by

JSR pix

For Basic, the point whose co-ordinates are X%,Y% will be plotted according to whether A% = 1 or A% = 0 respectively. For assembler, the co-ordinates are in the x and y registers and the plot/unplot flag in the accumulator. In both cases the parameters are unchanged on exit. Also, the respective initialising procedures must have previously been called once. This subroutine can be used in the construction of line, circle or triangle drawing-filling routines.

For an example of mode 7 pixel plotting see the Breakout/Breakthrough game in the May issue of *Your Computer* and note the smooth movement of the ball which could not be achieved in Basic or using a character-size ball.

The final listing — listing 4 — is a complete utility for use when your aim is to create a picture on the screen. It can be used as an easy alternative to the usual method of drawing your picture on divided-up graph paper and then leafing through the back of the manual to see which character is needed for each square on the screen. It is in Basic but uses the previous assembly routine to do any plotting-unplotting.

There are two stages to building up a picture in mode 7: first plotting pixels at the correct points, second putting the colour control codes at the correct places to give the desired colour layout. Thus the program has two mutually interchangeable modes: Pixel Mode — entered by pressing P: here you can move a flashing pixel cursor round the screen using the arrowed keys. If you want to fill in a pixel you press Copy, to rub one out you press D.

You can draw or undraw lines by moving the cursor while keeping Ctrl pressed or Shift pressed.

The other mode is colour mode — entered by pressing C. You can move a flashing cursor around the screen using the arrow keys. To enter a colour control simply press the function key which — when shifted or controlled — would normally generate that colour code.

A select number of other features, for example, flashing, can be obtained by pressing the relevant key on the keyboard. These are given on request in the program itself.

Note that you will have to append the two procedures from Pix to the program. Other commands include Save Screen — pressing S will at any time save the contents of the screen on to tape with the file name "Telepic". It can then be loaded back at a later date by either running the Telepic program and pressing L or by doing a *Load. ■

Listing 4.

```
   10PROCinit3
   20PROCsetup
   30CLS:PRINT'CHR$131"This is a MODE7 utility program to"'CHR$131"enable you to
 draw + save coloured"'CHR$131"pictures in real time in mode7"'CHR$131"in simila
r style to Etch-a-sketch."
   40PRINTCHR$134"You can be in PIXEL mode,when"'CHR$134"you fill pixels (or lin
es ofthem)"'CHR$134"or in COLOUR mode when youmove a"'CHR$134"cursor round the s
creen todeposit"
   50PRINTCHR$134"control codes according to which"'CHR$134"colour  control comm
and  buttons"
   60PRINTCHR$134"you press-"CHR$130"type I (for Info) at any"'CHR$130"stage to
remind yourself of buttons"'CHR$130"you can use."CHR$133"In the latter  mode"'CH
R$133"you may hear a constnt buzz.This is"
   70PRINTCHR$133"a warning that  the cursor is then"'CHR$133"positioned over a
full character"
   80PRINTCHR$133"square that is wholly or partially"'CHR$133"filled with contro
l characters or"'CHR$133"pixels respectivly."CHR$129"This is to help"'CHR$129"yo
u position contrl charactrs so"'CHR$129"that you dont rub out anything that"
   90PRINTCHR$129"you've already put there."
   100PRINTCHR$135;CHR$136;"          ( key to continue )";:X=GET
   110CLS:PRINT'CHR$131"You may want to use the permanent"'CHR$131"colour facilit
y also listed in"'CHR$131"which case you should use that and"'CHR$131"then reloa
d this program"
   120PRINT'CHR$134"You start off in PIXEL mode."'CHR$130"Hit a key for Info..."
:X=GET:mode$="Pixel setting":PROCinfo
   130REPEAT
   140mode$="Pixel setting"
   150PROCFlash_and_wait
   160ON Z% GOSUB 180,190,200,210,220,230,240,250
   170UNTIL FALSE
   180A%=1:PROCdot:RETURN
   190PROCfill_if_ctrl:PROCrub_if_shift:CX%=(CX%+77)MOD78:RETURN
   200PROCfill_if_ctrl:PROCrub_if_shift:CX%=(CX%+1)MOD78:RETURN
   210PROCfill_if_ctrl:PROCrub_if_shift:CY%=(CY%+74)MOD75:RETURN
   220PROCfill_if_ctrl:PROCrub_if_shift:CY%=(CY%+1)MOD75:RETURN
   230A%=0:PROCdot:RETURN
   240PROCcolour:RETURN
   250PROCinfo:RETURN
   260REM The following procedure initialises things for the
   270REM pix subroutine by defining constants,reserving RAMspace
   280REM and assembling the code.
   290
   300
   310DEF PROCsetup
   320DIM screenstore% 1023
   330VDU23,1,0;0;0;0;
   340rec%=8:KM%=28
   350DIM key%(rec%),key2%(KM%)
   360*FX4,1
   370CX%=0 : CY%=0
   380FOR I%=1 TO rec%
   390READ key%(I%)
   400NEXT
   410FORI%=1 TO KM%
   420READ key2%(I%)
   430NEXT
   440DATA -106,-26,-122,-42,-58,-51,-83,-38
   450DATA 136,137,138,139,129,130,131,132,133,134,135,145,146,147,148,149,150,15
1,72,82,70,66,68,32,83,76,80,73
   455 REM Line 460 is not necessary if programs 1 and 2 have previously been cal
led
   460CLS:FORI%=0 TO26:PRINT'CHR$150:NEXT:VDU28,1,24,39,0
   470ENDPROC
   480DEF PROCFlash_and_wait
   490REPEAT
   500A%=1:PROCdot:PROCW
   510W%=?char:
   520A%=0:PROCdot:PROCW
   530VDU31,X%DIV2,24-Y%DIV3,W%
   540*FX15,1
   550UNTIL FNvalid_input
   560ENDPROC
   570DEF FNvalid_input
   580true%=FALSE
   590FOR I%=1 TO rec%
   600IF INKEY(key%(I%))  true%=TRUE:Z%=I%
   610NEXT
   620=true%
   630DEF PROCdot
   640X%=CX%:Y%=CY%
   650CALL pix
   660ENDPROC
   670
   680DEF PROCfill_if_ctrl
   690IF INKEY(-2) A%=1:PROCdot
   700ENDPROC
   710
   720
   730DEF PROCrub_if_shift
   740IF INKEY(-1) A%=0:PROCdot
   750ENDPROC
   760
   770
   780DEF PROCW
   790FORT%=0TO35:NEXT
   800ENDPROC
   810
   820
   830DEF PROCcolour
   840*FX15,1
   850mode$="Colour setting"
   860VDU23,1,1;0;0;0;
   870PX%=0:PY%=0
   880PRINT;TAB(PX%,PY%);
   890G%=A%:A%=135:IF CHR$((USR(&FFF4) AND &FFFF) DIV&100) <>" " SOUND &12,-10,1,
1
   900A%=G%:R%=INKEY(1):IF R%=-1 GOTO890 ELSE PROCvalid2
   910 ON KP% GOSUB 940,950,970,960,980,980,980,980,980,980,980,980,980,980,980,9
80,980,980,990,1000,1010,1020,1030,980,1050,1060,1040,1070,1080
   920IFR%=80 ENDPROC
   930GOTO880
   940PX%=(PX%+39)MOD40:RETURN
   950PX%=(PX%+1)MOD40:RETURN
   960PY%=(PY%+24)MOD25:RETURN
   970PY%=(PY%+1)MOD25:RETURN
   980VDUR%:RETURN
   990VDU158:RETURN
   1000VDU159:RETURN
   1010VDU136:RETURN
   1020VDU157:RETURN
   1030VDU156:RETURN
   1040VDU23,1,0;0;0;0;:RETURN
   1050PROCsave:RETURN
   1060PROCload:RETURN
   1070PROCinfo:RETURN
   1080VDU7:RETURN
   1090DEF PROCvalid2
   1100KP%=0
   1110FOR I%=1 TO KM%
   1120IF key2%(I%)=R% KP%=I%
   1130 NEXT:IF KP%=0 KP%=I%
   1140ENDPROC
   1150DEF PROCsave
   1160*FX3,2
   1170VDU7,7,7,7,7
   1180*FX138,0,13
   1190*SAVE "SCREEN" 7C00 7FFF
   1200*FX3,0
   1210ENDPROC
   1220DEF PROCload
   1230*FX3,2
   1240*LOAD "SCREEN" 7C00
   1250*FX3,0
   1260ENDPROC
   1270DEFPROCinfo
   1280VDU23,1,0;0;0;0;:PROCbeep
   1290FORI%=0 TO 1023:?(screenstore%+I%)=?(HIMEM+I%):NEXT
   1300IF mode$="Pixel setting" GOTO 1360
   1310CLS:PRINTCHR$135;CHR$136"The commands available are:"'CHR$134"CTRL-FUNCTIO
N : Set graphics colour"'CHR$133"SHIFT-FUNCTION: Set alpha colour code"'CHR$13
2"P : Enter pixel-plotting mode"'CHR$131"S : Save screen to tape"'
   1320PRINTCHR$129"L : Load screen from tape"'
   1330PRINTCHR$134"P : Enter code for 'hold graphics'"'CHR$133"R : Enter code fo
r 'release graphics'"'CHR$132"F : Enter code for 'flashing graphics'"'CHR$131"B
 : Enter code for 'new backround'"'CHR$130"D : Enter code for 'black backround'
"
   1340PRINT'CHR$129"<SPACE> ; Enter a space"'CHR$135;CHR$136"( key to return to
screen )";:VDU23,1,1;0;0;0;:*FX15,0
   1350Z=GET:GOTO1390
   1360VDU12,10,135,136:PRINT"Commands valid for PIXEL mode are:"''''CHR$134"Curso
r keys : Move plot cursor"'CHR$133"CTRL: when held gives cursor trail"'CHR$132
"COPY : plots the current pixel"'CHR$131"D : Deletes  current pixel"'
   1370PRINTCHR$130"C : Enter colour code inserting mode"'CHR$130"    (for SAVE,LO
AD screens also)"''''CHR$135;CHR$136"( key to return to screen )":*FX15,0
   1380Z=GET
   1390FORI%=0 TO 1023:?(HIMEM+I%)=?(screenstore%+I%):NEXT
   1400ENDPROC
   1410DEFPROCbeep:SOUND&11,-15,30,2:ENDPROC
```

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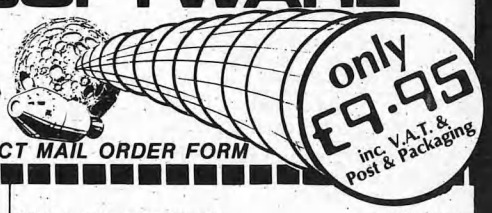

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```
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Start at location 16514 with the
ZXGT header .The two HALTs cause
the  rest of the statement to be
blanked out in BASIC.
        CP A
        CP L
        XOR H
        CP C
        HALT
        HALT
This  short section  contains  a
series  of fixed jumping  points
which  are used to get from  the
first half to the second half of
the code.
 L201:  JP L151 ;PRINT
 L202:  JP L131 ;SCROLL
 L203:  JP L51 ;GET KEY
 L204:  JP L53 ;TEST KEY
 L205:  JP L165 ;PAUSE
 L206:  JP L100 ;MULTIPLY
 L207:  JP 0 ;PLOT
 L208:  JP L60 ;RST 10
 L209:  JP L65 ;£B6B
 L210:  JP L20 ;DIVIDE
 L211:  JP L99 ;RANDOM
 L212:  JP L80 ;GETNUM
 L213:  JP L187 ;REM
 L214:  JP L241 ;SAVE
When the break key is pressed we
come to here and do a RST to the
ROM.
 L252:  RST 08
        ADC A,H
Routine to print a 16 bit signed
integer  which is held in the HL
register pair.  A leading  space
is added.
 L151:  PUSH HL
        PUSH DE
        XOR A
        CALL L60
        BIT 7,H
        JR Z,L153
        LD A,22
        CALL L60
        CALL L231
 L153:  LD DE,10000
        CALL L160
        JR NC,L154
        LD DE,1000
        CALL L160
        JR NC,L155
        LD DE,100
        CALL L160
        JR NC,L156
        LD E,10
        CALL L160
        JR NC,L157
        JP L158
 L154:  CALL L120
 L155:  LD DE,1000
        CALL L120
 L156:  LD DE,100
        CALL L120
 L157:  LD E,10
        CALL L120
 L158:  LD E,1
        CALL L120
        XOR A
        POP DE
        POP HL
        JP L60
 L160:  PUSH HL
        AND A
        SBC HL,DE
        POP HL
        RET
Repeatedly  Subtract DE from  HL
until the result is negative. If
A starts with character code  28
(=char  0) it finishes with  the
character code of the left  hand
digit  of  HL.  Print  this
character.
 L120:  LD A,28
        AND A
 L121:  SBC HL,DE
        JR C,L122
        INC A
        JR L121
 L122:  ADD HL,DE
        JP L60
Negate a 16 bit integer
 L231:  LD A,H
        CPL
        LD H,A
        LD A,L
        CPL
        LD L,A
        INC HL
        RET
Scroll the screen up 1 line
 L131:  LD HL,(16396)
        LD DE,33
        PUSH HL
        LD BC,0
        ADD HL,BC
        INC HL
        PUSH HL
        ADD HL,DE
        EX DE,HL
        LD HL,726
        SBC HL,BC
        EX (SP),HL
        POP BC
        EX DE,HL
        LDIR
        POP HL
        LD BC,£02B6
        ADD HL,BC
        LD (16398),HL
        LD A,33
        LD (£4039),A
        LD A,3
        LD (£403A),A
        RET
Wait  for  a key to be  pressed,
return  the  value  in  the  A
register and test for break. Rub
out  is  trapped and  waits  for
another key to be pressed.
 L51:   CALL £2BB
        INC H
        JR NZ,L51
 L57:   CALL £2BB
        LD A,L
        CP £FF
        JR Z,L57
 L54:   LD BC,£FD7F
        XOR A
        PUSH HL
        SBC HL,BC
        POP HL
        JP Z,L252
        LD BC,£FCEF
        XOR A
        PUSH HL
        SBC HL,BC
        POP HL
        JR Z,L51
        LD B,H
        INC H
        RET Z
        LD C,L
        CALL £7BD
        LD A,(HL)
        CP 0
        RET
See if any key is pressed, works
like INKEY£
 L53:   CALL £2BB
        LD A,H
        CP £FE
        JR Z,L51
        JR L54
Pause  for n  1/50ths of  a  sec
leaving if a key is pressed.
 L165:  SET 7,H
        LD (16436),HL
 L166:  LD HL,(16436)
        LD A,H
        AND £7F
        OR L
```
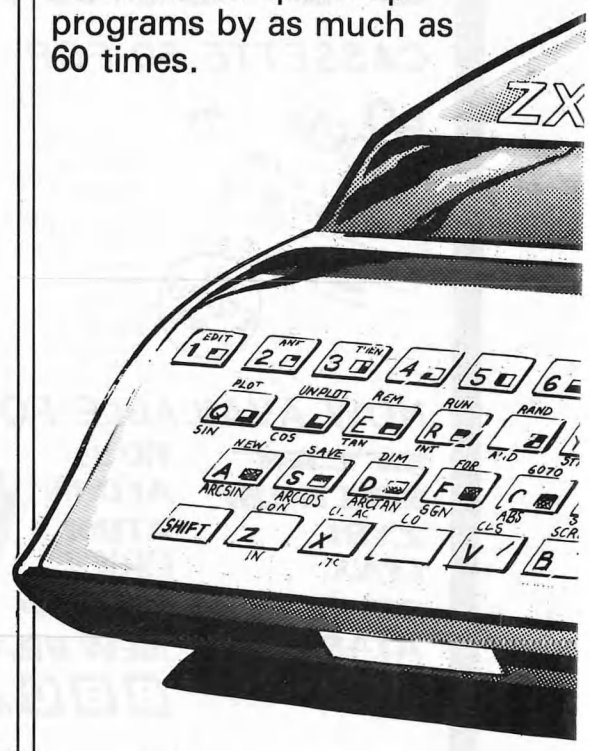
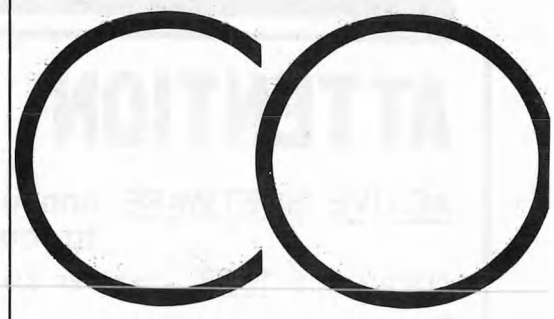

ZX-81

This compiler by David Threlfall will speed up programs by as much as 60 times.

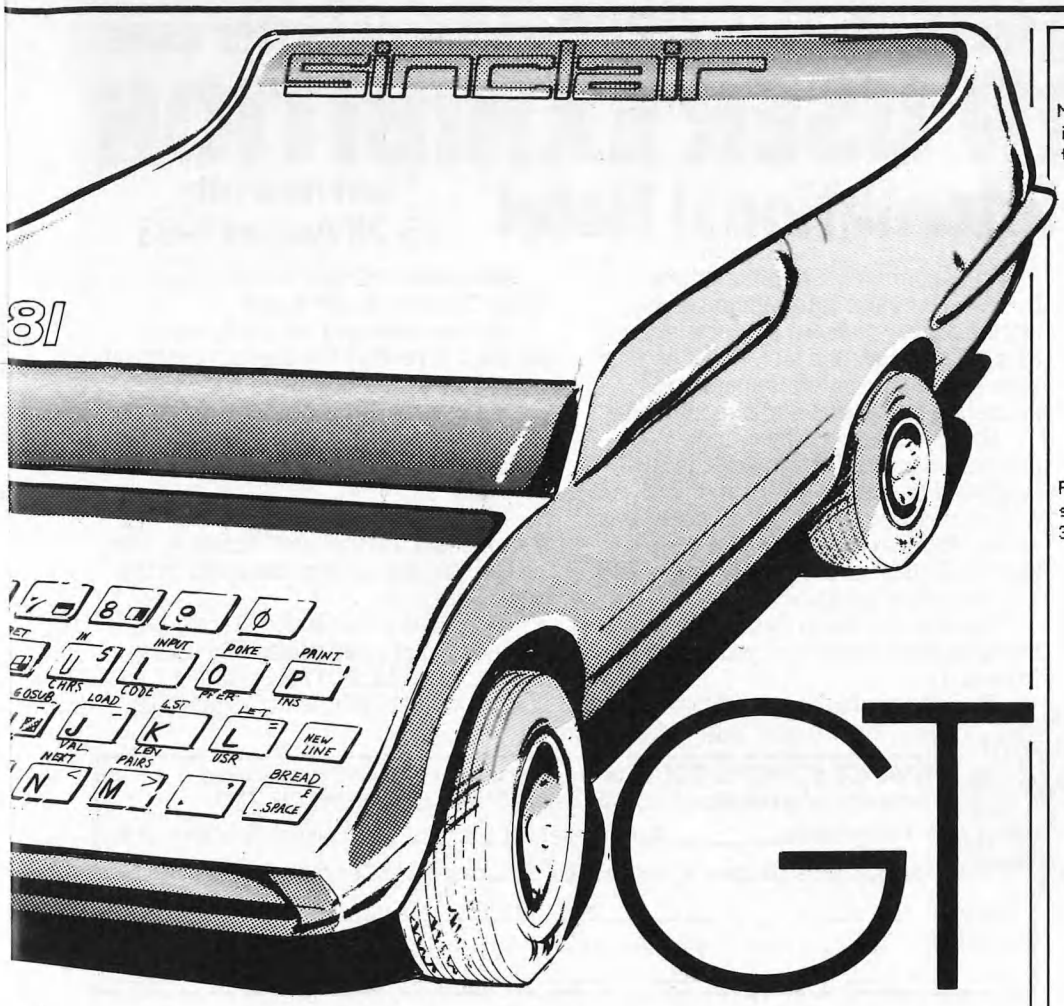




THE AIM OF this short series is to explain how it is possible to write a compiler for a machine as small as the ZX-81. We will look at the way that some of the Basic statements are translated — compiled — into machine code, and then go on to discuss extending the simple compiler to encompass string handling, multiple arrays and full variable names.

Why compiled Basic? Basic was written as an easy-to-learn language and to make it easy to run it was designed to be interpretative. This means that as each line of code is executed it is "retranslated" into a succession of calls to machine-code subroutines stored in the Basic ROM. This does not mean that Basic is translated into machine code — far from it — that is the purpose of a compiler. This method makes the language very easy to work with, particularly for developing a program, but slow to run.

Many compilers exist for the larger desk-top computers such as TRS-80, Pet, Apple and CP/M-based machines but those offering full floating-point arithmetic produce code only a few times faster than interpretative Basic as



ZXGT COMPILER

most of the time is spend executing maths routines in the ROM rather than interpreting the code. ZXGT is the first true compiler small enough to fit into the ZX-81. To provide the necessary speed for games as well as to keep the compiler small — it is only just over 2.3K bytes — it only runs integer Basic and so is restricted to numbers from -32768 to 32767 with no strings or Boolean operations. The result is extremely fast code.

Before we discuss writing a compiler in detail it might be as well to define the purpose of a compiler. Essentially there are two main types of compiler, the first takes each line of Basic and converts it into a very compact set of simple instructions which are interpreted by a run-time system. The second type takes the lines of Basic and generates machine-code statements which carry out the functions of the Basic. Amongst these statements there may be calls to larger hunks of machine code within the operating system.

The first type of compiler produces very concise code but it cannot be executed directly by the microprocessor; instead, it is interpreted. The second type of compiler produces somewhat longer code which is directly executable and much faster.

When the design of this compiler was contemplated, experience of other compilers such as Microsoft and Accel led to the conclusion that "speed meant integer". To get the most speed the generation of an intermediate was rejected in favour of a mixture of pure machine code and calls to a library of fast routines within the compiler run-time system. It was expected that this would lead to an average speed up to about 20 times; in the event it was almost three times better than this.

The ZX-81 is a good target for a compiler for several reasons. First, its interpretative Basic is very slow. On standard benchmarks running in Slow mode it is 10 times slower than the BBC machine making it impossible to write good games in Basic. A compiler would increase the speed and integer arithmetic should be sufficient for most games.

Second, its Basic, in common with many

(continued on page 135)

```
        RET Z
        CALL L53
        JR Z,L166
Multiply  two 16 bit  signed
integers  together.  One in  HL,
the other in DE. Result in HL.
L100:   LD B,16
        LD C,D
        LD A,E
        EX DE,HL
        LD HL,0
L101:   SRL C
        RRA
        JR NC,L102
        ADD HL,DE
L102:   EX DE,HL
        ADD HL,HL
        EX DE,HL
        DJNZ,L101
        RET
Plot  or  unplot a pixel on  the
screen.  Assumes a full 24  line
32 character screen.
L0:     LD A,£2B
        SUB B
        JP C,L253
        LD B,A
        LD A,1
        SRA B
        JR NC,L1
        LD A,4
L1:     SRA C
        JR NC,L2
        RLC A
L2:     PUSH AF
        CALL L15
        LD A,(HL)
        RLC A
        CP £10
        JR NC,L4
        RRC A
        JR NC,L3
        XOR £8F
L3:     LD B,A
L4:     LD DE,£0C9E
        LD A,(£4030)
        SUB E
        JP M,L6
        POP AF
        CPL
        AND B
        JR L7
L6:     POP AF
        OR B
L7:     CP 8
        JR C,L8
        XOR £8F
L8:     JP L60
L15:    LD A,23
        SUB B
        JP C,L253
        LD A,C
        AND £1F
        LD C,A
        PUSH BC
        PUSH BC
        PUSH BC
        XOR A
        RL B
        RL B
        RL B
        LD L,B
        LD H,A
        ADD HL,HL
        ADD HL,HL
        POP BC
        LD C,B
        LD B,A
        ADD HL,BC
        POP BC
        LD B,A
        ADD HL,BC
        LD BC,(16396)
        ADD HL,BC
        INC HL
        LD (16398),HL
        POP BC
```

(listing continued on page 135)

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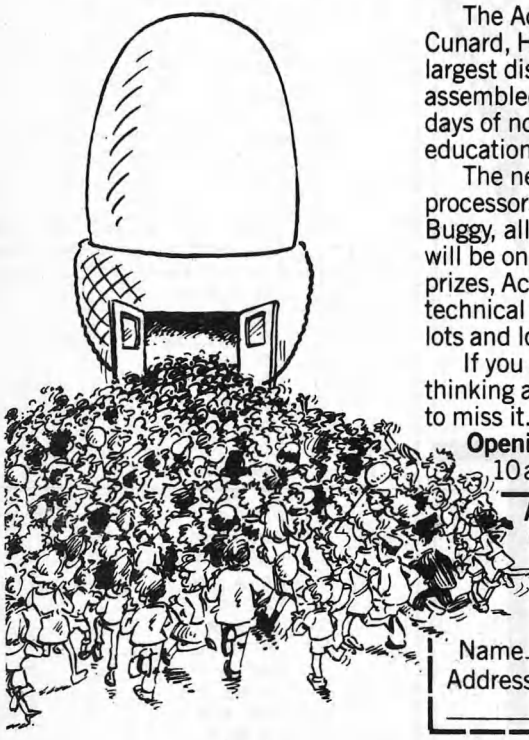

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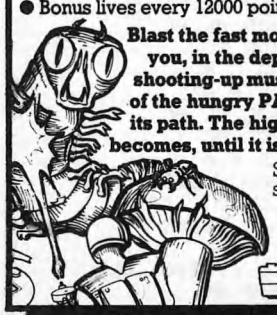

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(continued from page 133)
other machines, is tokenised, this means that all reserved words such as Let, Print and so on are represented as a single byte of code. This makes them very easy for the compiler to recognise.

Its Basic is rigorous. You may not leave out Let as in many Basics and after Then the word Goto may not be omitted.

The Basic is syntax-checked on input, so much of the error checking is already done. In fact, the only "errors" which can now occur arise where a particular function — such as strings — is not supported by the compiler.

The decision to restrict the scope of the compiler was taken for several reasons. The first was that the compiler was written in assembler language rather than in machine code, and only about 1.5K's worth of machine code can be held in assembler in a 16K machine. The compiler was written in two roughly equal sections yielding a total of 2,300 bytes of machine code. Also, the ZX-81 has no discs and only a very slow tape interface, so the compiler has to be in memory at the same time as both the original Basic and the machine code generated by the compiler. So keeping it small was important.

The first restriction to be imposed was to limit single letter variables, A-Y. By having only 25 variables a predefined area of memory can be set aside for them which may be accessed by adding the base address of this area to the position of the letter in the alphabet. This position is fixed in the compiler and if a variable is required the code to load it into the accumulator can be written by the compiler.

Next, the compiler was limited to one array — Z. By having only one array, which may be of any size that will fit in the machine, it can be placed above the Basic system and below the machine stack.

Furthermore, strings were omitted to keep the compiler small and to avoid the dynamic allocation of space their use entails. Dynamic allocation means that as the string gets longer more space is made for it; this can be slow.

For loops in this compiler have only positive single increments; the Step keyword is not supported. Also Boolean algebra — And, Or and Not — is not available.

Arithmetic expressions, except in Let statements, must be enclosed in parentheses as this makes the scope of the expression considerably easier to assess. This does not invalidate execution of the code in normal interpretative mode.

As regards the interface to Sinclair's Basic ROM, where possible the standard routines in the Sinclair ROM were used, but it soon became clear that in many cases this would not be possible. Two particular examples where it would at first seem possible to use the ROM routines but where it was decided to write special routines are worth considering.

Try plotting at every point on the screen and by careful observation you might notice that the top right-hand corner takes 70 percent longer to plot than the bottom left. Because of the variable length lines which are possible with the 1K RAM, the machine takes a long time to calculate where a particular point is in

(continued on page 137)

(listing continued from page 133)

```
        LD A,24
        SUB B
        LD (16442),A
        LD A,33
        SUB C
        LD (16441),A
        RET
```

Print the character ot token that is held in the A register. If we are at the bottom of the screen then display a ? and wait for a key to be pressed. If it is the COPY key make a copy. If it is the SLOW key scroll up at two lines per second. If it is the CONTINUE key then clear the screen and continue. Break returns to BASIC. Any other key causes a fast scroll.

```
L60:    PUSH DE
        PUSH HL
        PUSH BC
        PUSH AF
        LD A,(16442)
        CP 2
        JR Z.L63
        POP AF
L73:    CP 118
        JR Z,L61
        CP 64
        JR NC,L68
L78:    LD HL,(16398)
        LD (HL),A
        INC HL
        LD (16398),HL
        LD A,(16441)
        DEC A
        LD (16441),A
        LD A,(HL)
        CP 118
        JR NZ,L64
L62:    LD A,(16442)
        DEC A
        LD (16442),A
        INC HL
        LD (16398),HL
        LD A,33
        LD (16441),A
        JR L64
L61:    LD HL,(16398)
L74:    LD A,(HL)
        CP 118
        JR Z,L62
        INC HL
        JR L74
L63:    LD HL,(16396)
        LD BC,760
        ADD HL,BC
        LD A,143
        LD (HL),A
L66:    CALL L53
        JR Z,L66
        CP 40
        JR Z,L67
        CP 63
        JR Z,L75
        CP 41
        CALL Z,L76
        CALL L131
        JR L79
L67:    CALL £A2A
L79:    POP AF
        JR L73
L64:    POP BC
        POP HL
        POP DE
        RET
L75:    CALL £869
        JR L66
L76:    LD HL,10000
L77:    DEC HL
        LD A,L
        OR H
        JR NZ,L77
        RET
```

Print a sequence of characters. DE points to where the characters are and BC is the number of them there are. Printing is started at the present cursor position.

```
L65:    LD A,B
        OR C
        RET Z
        LD A,(DE)
        CALL L60
        INC DE
        DEC BC
        JR L65
```

Expand Tokens into the full keywords adding blanks front and back where necessary.

```
L68:    CP 67
        JR C,L69
        CP 192
        RES 6,A
        JP C,L78
        AND £3F
L69:    LD HL,£111
        LD B,A
        INC B
        CP 33
        JR NC,L70
        XOR A
        CALL L60
L70:    BIT 7,(HL)
        INC HL
        JR Z,L70
        DJNZ,L70
L71:    LD A,(HL)
        BIT 7,A
        JR NZ,L72
        CALL L60
        INC HL
        JR L71
L72:    AND £3F
        CALL L60
        XOR A
        JP L73
```

An overflow of some sort has occured so report an error B.

```
L253:   RST08
        ADC A,D
```

Divide the signed integer in HL by the signed integer in DE, result is in HL.

```
L20:    LD A,E
        OR D
        JR Z,L253
        CALL L40
        PUSH BC
        LD A,H
        OR D
        RLCA
        JR C,L253
        LD C,E
        LD B,D
        LD DE,0
        PUSH DE
        EX DE,HL
        INC HL
L21:    ADD HL,HL
        EX DE,HL
        ADD HL,HL
        LD A,C
        SUB L
        LD A,B
        SBC A,H
        EX DE,HL
        JR NC,L21
        EX DE,HL
L22:    EX DE,HL
L35:    XOR A
        LD A,H
        RRA
        LD H,A
        LD A,L
        RRA
        LD L,A
        OR H
        JR Z,L23
        EX DE,HL
        XOR A
```

(listing continued on page 137)

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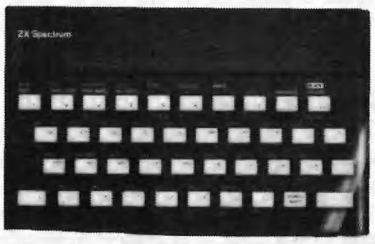

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(continued from page 135)

the Display File. Using the entry point given in Mr Logan's book on the ZX-81 ROM it was possible to make the plotting an average four times faster if called from machine code. By modifying the calculation of the Display File address, knowing that ZXGT will only run on a 16K machine, it can be made 35 times faster than Basic.

The second problem is that if a Print causes the screen to be full after a call to Sinclair's printing routine, an error 5 results. When using Basic pressing Continue allows the screen to clear and the program to go on. However, if a machine-code program causes this to happen it will not return to that machine-code program. For this reason new Screen-handling routines are built into ZXGT which do not call the ROM. The final version handles all keyword expansion and, when the screen is full, gives you several options.

You can Press C to continue as before; or press D/Slow and the screen will scroll up at about two lines per second while your finger is on the key. Alternatively press Z/Copy and a copy is made on to the ZX Printer. A fourth option is to press any other key than C, D, Z and Break and the screen scrolls at speed — up to about 40 lines per second. The scroll is much faster than Sinclair's and does not result in a fragmented Display File which is hard to clear. Try a screen of Scrolls in Basic followed by CLS; it takes several seconds to clear.

Figure 1. The column on the right shows how many times faster ZXGT is.

Test	ZXGT (seconds)	ZX-81	
1. For-Next loop * 1000	0.11	19	172
2. If loop * 1000	0.30	27.4	91
3. As 2 + A=L/L*L+1-L	2.6	65	25
4. A$ 2 + A=L/2*3+4-5	5.0	63	13
5. As 4 + GoSub	5.0	79	16
6. As 5 + inner For loop	5.7	206	36
7. As 6 + Array assign	7.0	280	40
			Average 56

The speed improvement of ZXGT over Sinclair Basic is spectacular, varying from 13 to 172 times faster than Basic in the same mode — Slow or Fast.

For example, a For loop of 1,000 steps in interpreted Basic takes 19 seconds in Slow mode while ZXGT takes a little over 0.1 seconds. To get a feel for how quick this is, if this is run in Fast mode under ZXGT it takes 0.03 seconds and, by comparison, a large mainframe computer running Fortran needs 0.001 seconds. In addition, the order of statements no longer matters for speed.

On the standard benchmarks the Slow mode comparisons between ZXGT and Basic were as shown in figure 1.

It is difficult to comprehend what a factor of 60 speed-up on a program means until you realise one hour becomes one minute.

Now for the Assembler listing: those who wish to assemble the ZXGT code given with these articles should note the following. All numbers starting $ are hexadecimal. All RST commands are in hex but the dollar is not given. The labels are L0 to L255. All comment lines should be omitted. This is one third of the code. You will require a Rem of length 2,303 bytes as the first line in the machine. Note that this means that

PEEK 16511 + 256 * PEEK 16512 = 2303

The remaining two-thirds of the code almost fill the machine by themselves, so this third must be assembled and then deleted.

The entry point to the complete compiler is 17389 — use Rand Usr 17389 — for the code to be put in a Rem at line two or 17381 if you wish it to ask where the code is to be put.

The entry to the code generated by ZXGT is at 18823.

Next month we shall give details of the way that the compiler translates Basic with examples from the standard Basic repertoire. We shall also supply a complete listing of the compiler in machine code. ■

(listing continued from page 135)

```
        RR H
        RR L
        LD A,C
        SUB L
        LD A,B
        SBC A,H
        JP M,L22
        LD A,C
        SUB L
        LD C,A
        LD A,B
        SBC A,H
        LD B,A
        EX (SP),HL
        ADD HL,DE
        EX (SP),HL
        JR L22
L23:    POP HL
        POP BC
        BIT 7,B
        JP NZ,L231
        RET
```

Find the sign of the division and make both divisor and dividend positive. Sign is in B.

```
L40:    LD B,H
        LD A,H
        RLA
        CALL C,L231
        EX DE,HL
        LD A,H
        XOR B
        LD B,A
        BIT 7,H
        JP NZ,L231
        RET
```

Generate a pseudo random integer number using the standard Sinclair Seed. The result is always between 0 and 32768.

```
L99:    LD DE,(16434)
        LD H,E
        LD L,£FD
        LD A,D
        OR A
        SBC HL,DE
        SBC A,0
        SBC HL,DE
        SBC A,0
        LD E,A
        LD D,0
        SBC HL,DE
        JR NC,+1
        INC HL
        LD (16434),HL
        RES 7,H
        RET
```

Make a REM statement to contain the code which we are generating. This REM always contains two 118's at the start to stop BASIC trying to list the machine code. There is a call to ROM in here and this routine must be executed in FAST mode. The length of code arrives in BC. On return HL is the address of the first location available. 18816 is the location of the first character in the REM.

```
L187:   INC BC
        INC BC
        PUSH BC
        LD HL,6
        ADD HL,BC
        LD B,H
        LD C,L
        LD HL,18816
        CALL £9A3
        INC HL
        LD A,118
        LD (DE),A
        LD (HL),0
        INC HL
        LD (HL),2
        INC HL
        POP BC
        INC BC
        INC BC
        LD (HL),C
        INC HL
        LD (HL),B
        INC HL
        LD (HL),234
        INC HL
        LD (HL),A
        INC HL
        LD (HL),A
        INC HL
        RET
```

Get a signed integer from the keyboard - used for INPUT and to ask user where the code should be put (see the second half of the code).

The result is returned in the HL register pair.

```
L80:    LD HL,0
        PUSH HL
L82:    PUSH HL
L89:    CALL L51
        CP 22
        JR NZ,L87
        POP HL
        POP DE
        PUSH AF
        PUSH HL
        CALL L60
        JR L89
L87:    CP 118
        POP HL
        JR Z,L88
        ADD HL,HL
        PUSH HL
        ADD HL,HL
        ADD HL,HL
        POP DE
        ADD HL,DE
        SUB 28
        LD B,0
        LD C,A
        ADD HL,BC
        ADD A,28
        CALL L60
        JR L82
L88:    POP AF
        CALL Z,L231
L92:    RET
```

Save the code away into the the location pointed to by location 16507. If the SLOW key is pressed display the location and contents - useful in debugging.

```
L241:   PUSH BC
        PUSH HL
        LD HL,(16507)
        PUSH AF
        LD (HL),A
        PUSH HL
        INC HL
        LD (16507),HL
        CALL L53
        CP 41
        JR NZ,L242
        LD A,118
        CALL L60
        POP HL
        CALL L151
        POP AF
        LD H,0
        LD L,A
        CALL L151
        JR L243
L242:   POP HL
        POP AF
L243:   POP HL
        POP BC
        XOR A
        RET
```

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Fast mode is all very well but the screen goes blank. Richard Taylor has a compromise.

SPEED AND SCREEN

Listing 1.

```
16514-253 203
16516-59 246
16518-205 7
16520-2 221
16522-33 142
16524-64 201
16526-237 95
16528-1 1
16530-25 62
16532-245 205
16534-181 2
16536-205 146
16538-2 205
16540-32 2
16542-221 33
16544-165 64
16546-195 164
16548-2 211
16550-253 58
16552-40 64
16554-198 194
16556-50 40
16558-64 205
16560-146 2
16562-205 32
16564-2 221
16566-33 142
16568-64 195
16570-164 2
```

Listing 2.

```
 1 REM
10 FOR A=16514
   TO 16571
20 INPUT B
30 SCROLL
40 PRINT A,B
50 POKE A,B
60 NEXT A
```

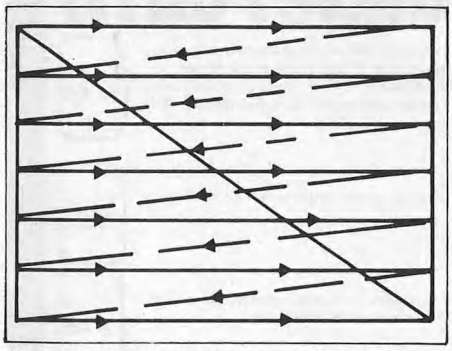


Figure 1. An exaggerated illustration of TV screen scanning. The unbroken line is the active line, the dotted line is the line retrace and the long line from bottom right to top left is the end-of-screen retrace. The lines on the next screen of information will be in the gaps betwen these lines.

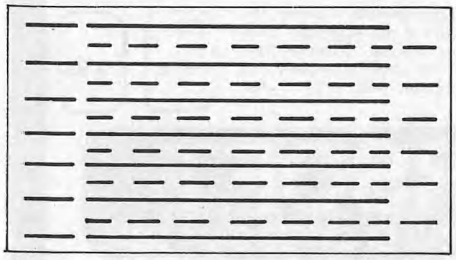


Figure 2. The even lines are transmitted in the first screen of information. The odd — dotted — lines are transmitted in the second screen of information.

THE CULMINATION of this article will be a machine-code program for any memory size ZX-81 which will allow you to run Basic programs in Slow mode at twice the normal speed. It does this by creating an intemediary between Fast and Slow mode. The operating characteristics are similar to those of slow mode except that there is a slight lack of contrast and some screen flicker is introduced.

The program in listing 2 is a hexadecimal loader program for entering the machine code. Line 1 is a Rem statment followed by 70 Xs. The actual machine code is shown in listing 1. Each byte should be entered, followed by Newline. Care should be taken to ensure that each byte is entered into the correct address. When you have finished, delete all lines except the line 1 Rem statement which now holds the machine code. Save a version on tape. Enter:

RAND USR 16514

and Newline. If all is well then characters should appear to be composed of small dots and the screen should flicker slightly. The machine will return to Slow mode if Fast, Slow, Pause, Copy, LList or LPrint are used; it will also return to slow mode if a program line is entered.

A program must contain the Rem statement if it is to use this new mode. The statement

RAND USR 16514

can be used as a program line as well as a direct command. The program has many uses and existing software can easily be converted to use this new facility.

Normally the ZX-81 spends 75 percent of its time on updating the display. My program decreases this to only 50 percent. The consequences of this are that some display flicker is introduced and the display loses some of its contrast. To understand how the program works, it helps to know a bit about how a TV works. A television display is made up of a fast-moving beam of electrons which bombards the phosphor-coated screen and makes it glow. The amount the phosphor

(continued on next page)

(continued from previous page)

glows is proportional to the intensity of the electron beam which is controlled, in this case, by the computer.

The beam moves too fast for the human eye to see its individual movements. The beam travels in an ordered and logical way in order to be sure that it visits every part of the screen. Its movement can be likened to reading a book. It starts at the top left-hand corner and travels horizontally from left to right. When it reaches the extreme right-hand side it flies back to the left hand side, sufficiently below the previous scan line to allow another scan line to be inserted between the first two later.

The beam carries on doing this until it reaches the bottom right-hand corner, then covers the whole screen again, except this time it is filling the gaps between the first set of scan lines. When the beam reaches the bottom right-hand corner again it will return to the top and the entire cycle will be repeated again.

The ZX-81 signal starts at the top by transmitting 55 white lines, followed by 192 lines which contain the actual active screen area. Each character is eight lines high and there are 24 rows of characters: eight times 24 equals 192.

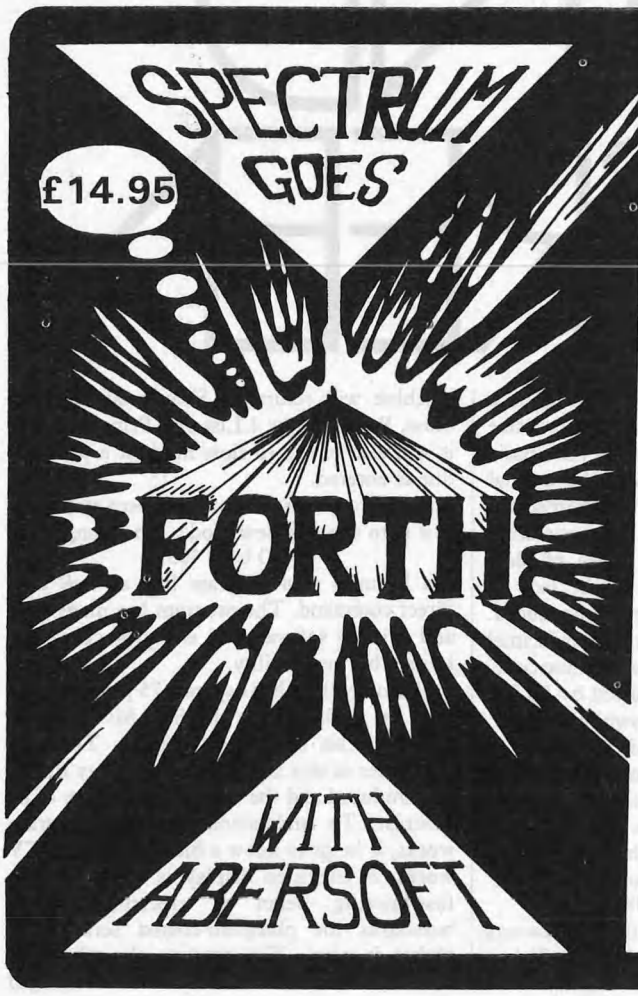
Then there are another 55 white lines. This adds up to 302 lines which is about half of 625 lines — the total number of lines displayed by television receivers in this country. It is not exactly half because some extra blank lines are transmitted while the computer is reading the keyboard — which it does 50 times every second — and incrementing the Frames counter.

Exactly the same picture is transmitted on both the odd and even screens of the signal. The ZX-81 actually executes the program during the 110 blank lines. The rest of the time its services are needed to supervise the television display hardware. If some way of increasing the number of blank lines, without seriously reducing the picture quality, could be found then program would run much faster.

The best method is to only transmit the picture on the even lines and to transmit blank lines during the whole of the odd screen. ■

Disassembled machine-code listing.

```
            SET 6,(IY+59)      This puts the machine into
            CALL 519           SLOW mode
            LD IX,LABEL A      Set interrupt vector to
                               start of new display routine
            RET                Return to Basic
LABEL A     LD A,R
            LD BC,6401
            LD A,245           Output the display. This only
            CALL 693           happens on even lines.
            CALL 658
            CALL 544           Read keyboard and
                               increment frames counter.
            LD IX,LABEL B      Set interrupt vector to start
                               of display routine for odd lines.
            JP 676              Return to interrupted program.
LABEL B      OUT 253,A          Makes sure that all future
                                interrupts will be of the
                                non-maskable type.
             LD A,(16424)       Number of blank lines above or
                                below active screen.
             ADD A,194          Add an extra 194 lines
             LD (16424),A       Restores new value
             CALL 658           Initiates the value into
                                the system.
             CALL 544           Read keyboard and increment
                                frames counter.
             LD IX,LABEL A      Let next interrupt be to the
                                even line routine
             JP 676             Return to interrupted program.
```

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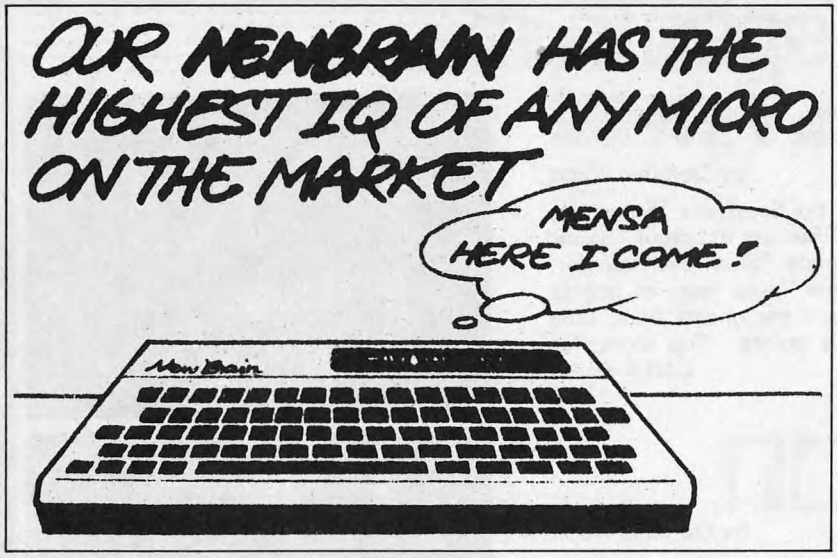

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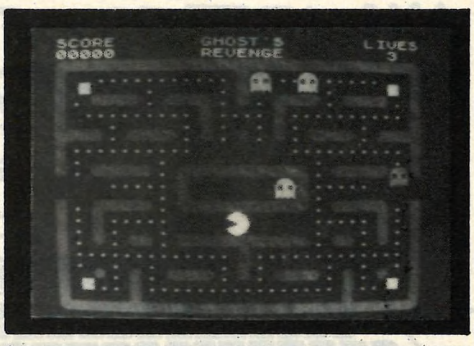

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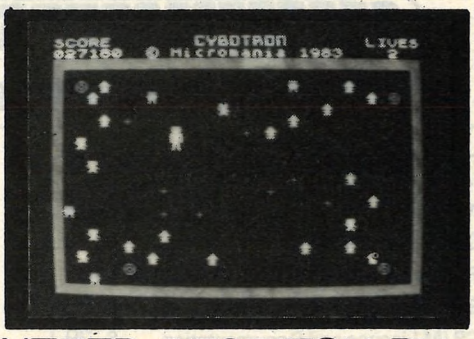

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Darryl Mattocks continues his guide to 6502 machine code with a look at the multiply function.

6502 MACHINE CODE MADE EASY

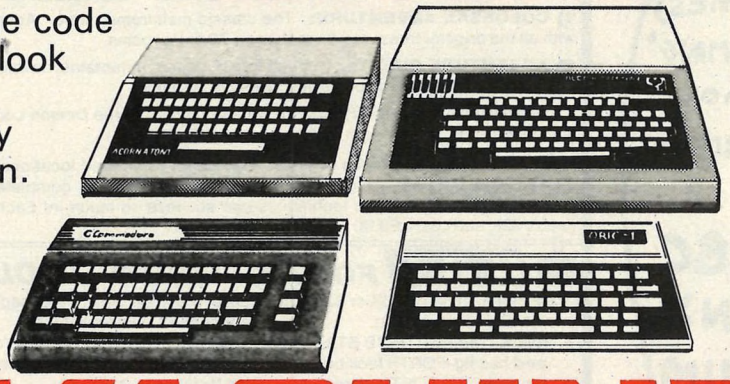
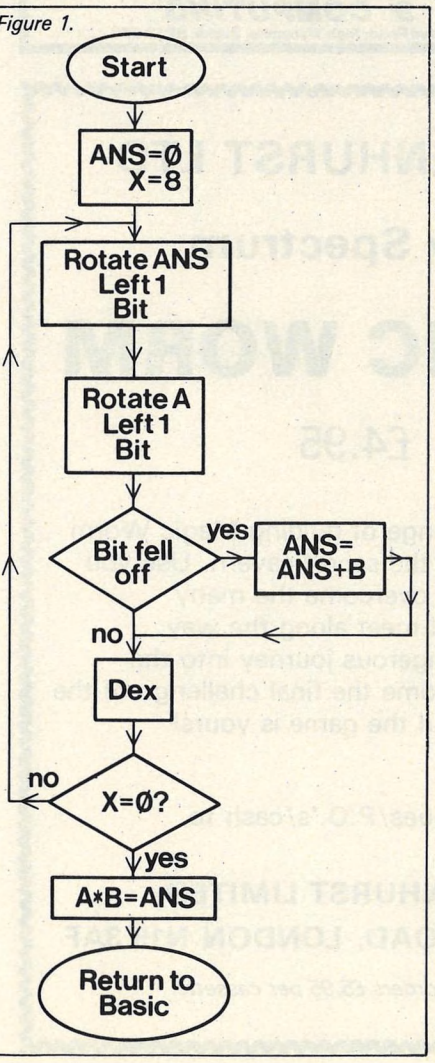


Figure 1.



OUT OF A possible 17,000 different possible mnemonics, the 6502 uses a whole 56, and not one of them is a multiply function. So how do you get to use the asterisk on a 6502-based machine?

Let us start from basics and look at the way in which we carry out normal, everyday decimal long multiplication. For example:

```
   183
   215*
   ----
   915
  1830+
 36600+
 ------
 39345=
```

What we are in fact doing is starting with the right-most digit of the 215 — the multiplier, that is, the 5, and multiplying it by the 183 — the multiplicand. This is then repeated for the other digits, steadily shifting the answer one place to the left and adding the results to a running total.

This is gruesome, but in binary all of the smaller calculations are much easier to work out. Let us now try and multiply 183 by 215 in binary.

183 dec = B7 hex = 10110111 binary
215 dec = D7 hex = 11010111 binary

Thus we see that 183 multiplied by 215 in binary is:

```
        10110111
        11010111*
        --------
        10110111
       101101110+
      1011011100+
     00000000000+
    101101110000+
   0000000000000+
  10110111000000+
 101101110000000+
 ---------------
 1001100110110001=
```

```
carry  111100111100011
```

Then

```
                10110111
                11010111*
                --------
=1001 1001 1011 0001
= 9    9    B    1
=9*4096+9*256+11*16+1
=39345
```

The adding in the middle of the calculation looks easy, but has its snags. When adding 1+1+1+1 the answer is 0 carry 4, that is 100 binary, so put a 1 in the carry position two places to your left, one place to the left for a carry 2, three for an 8 and so on.

As you can see, the binary multiplication works in the same way as decimal, so put this method into a flowchart and code it. Try multiplying A by B — see figure 1.

This routine is quite sneaky in that instead of shifting the "semi-products" one place to the left each time, it shifts the answer in the same way. This makes the adding up in the middle a lot easier.

The next problem is "shifting" the answer left by one bit. Here are two labour-saving commands:

ASL — Arithmetic Shift Left
ROL — Rotate left by one bit

ASL takes the content of either the accumulator or memory and shifts it one place to the left, catching the bit which falls off the end in the carry flag and adding a zero on the left.

```
C◄B7◄B6◄B5◄B4◄B3◄B2◄B1◄B0◄0
carry   accumulator
```

Or look at it this way:

	Carry	Accumulator
Before	0	10101011
ASL	0	10101011
After	1	01010110

ROL is similar to ASL but instead of catching the left-most bit in the carry flag and adding a zero, it uses the carry as a ninth bit. As before it rotates either memory or accumulator one bit to the left but instead of adding a zero it adds the contents of the carry flag. It still catches the fall-off bit in the carry flag as before. So:

```
C◄B7◄B6◄B5◄B4◄B3◄B2◄B1◄B0◄C
carry   Accumulator   carry
```

Notice how the carry flag has been accessed twice during the one command. Or:

	Carry	Accumulator
Before	1	00101100
ROL	1	00101100 ◄ 1
Leaving	0	01011001

To rotate a 16-bit number we need to use an ASL on the least significant byte — lo-byte — followed by a ROL on the most significant byte — hi-byte.

So if we have

```
Answer = Hi-byte  Lo-byte
       = 00001010 10101011
```

Then ASL the lo-byte:

	Carry	Lo-byte
Before ASL	?	10101011
Leaving	1	01010110

Then ROL the hi-byte:

	Carry	Hi-byte
Before ROL	1	00001010

(continued page 145)

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Program 2. Basic program.

```
10 C=0:RESTORE:POKE56,26:POKE52,26
20 READA$:IFA$="999"THEN50
25 D1$=LEFT$(A$,1):D2$=RIGHT$(A$,1)
30 A=(ASC(D1$)-48+((ASCD1$)>64)*7))*16
35 A=A+(ASC(D2$)-48+((ASC(D2$)>64)*7))
40 POKE6700+C,A:C=C+1:GOTO20
50 INPUT"IN A*B,WHAT IS A ";A:POKE0,A
60 INPUT"WHAT IS B";A:POKE1,A
70 SYS6700
80 PRINT"THEN A*B ="PEEK(2)+256*PEEK(3):
GOTO50
90 DATA A2,08,A9,00,85,02,85,03,06,02,26,
03,06,00,B0,04
100 DATA CA,D0,F5,60,18,A5,02,65,01,85,02,
A5,03,69,00,85
110 DATA 03,4C,3C,1A,999
```

Program 1. Disassembly of program 2.

ADDRESS	OPCODE	MNEMONIC	COMMENT
1A2C	A2 08	LDX #$08	X IS THE BYTE COUNTER
1A2E	A9 00	LDA #$00	SET ANSWER TO 0
1A30	85 02	STA $02	
1A32	85 03	STA $03	
1A34	06 02	ASL $02	SHIFT ANSWER LEFT 1 BIT
1A36	26 03	ROL $03	
1A38	06 00	ASL $00	SHIFT MULTIPLIER 1 BIT
1A3A	B0 04	BCS $1A40	ADD MULTIPLICAND ?
1A3C	CA	DEX	DECREMENT BIT COUNTER
1A3D	D0 F5	BNE $1A34	REPEAT FOR NEXT BIT
1A3F	60	RTS	RETURN TO BASIC
1A40	18	CLC	
1A41	A5 02	LDA $02	ANS=ANS + MULTIPLICAND
1A43	65 01	ADC $01	
1A45	85 02	STA $02	
1A47	A5 03	LDA $03	
1A49	69 00	ADC #$00	
1A4B	85 03	STA $03	
1A4D	4C 3C 1A	JMP $1A3C	

(continued from page 143)

Leaving 0 00010101

So now:

Answer = Hi-byte Lo-byte
= 00010101 01010110

Now rotating any 16-bit number should present no problems.

We can also use the ASL function to check whether a bit fell off in the multiplier by testing the carry bit afterward with the Branch if Carry Set — BCS — function.

In program 1, byte 0 is the multiplier, byte 1 is the mutiplicand, byte 2 is the lo-byte of the answer, and byte 3 is the hi-byte of the answer.

Use program 2 to Poke in the machine code; do not forget to Save it before running it.

In lines 20-40 the machine code is loaded from the Basic program into memory. Lines 50-80 contain a routine which Pokes the multiplier and multiplicand into place and then runs the machine code and decodes the answer.

Note that the two numbers to be multiplied must be only one byte large between zero and 255 and thus the largest possible result is

$$255 \times 255 = 63500$$

This one-byte limit is really only for convenience and it may be extended. In program 4 the maximum values are:

4 294 967 296 * 4 294 967 296 =
18 446 744 000 000 000 000

If speed is of the essence, then it would be stupid to use the previous routine to work out the position on the screen of something whose position is y lines down when A = 22 all of the time.

Why not work out in advance what the program would do for multiplying

y*22

and then key it straight in. It takes up more memory but depending on the multiplier, it can be much faster. The program to multiply the y co-ordinate by 22 is given in figure 2.

If you have tried any machine-code programming of your own you may have realised just what a pain it actually is. After writing the program, you look up the op-codes for the mnemonics in hex and then go through again filling in things such as jumps, subroutine calls, branches.

Almost invariably it ends up being gone through again correcting mistakes made during previous run-throughs. This process works — I used it for two years with moderate success — but it is long, slow and very tedious. Why not write a program to do it for you then? The end result will be either a monitor or an assembler.

Let us now assume that you have wised up to the encoding problem, and after looking through the adverts in this magazine, you have rushed out and bought a monitor which now sits, dead, in front of you. What can it do?

As a start, let me point out that there are many different makes of monitor available, but almost all good monitors will have: a mini-assembler-disassembler; Save and Load features for storing programs on cassette or disc; some kind of memory-examine and memory-fill feature.

Optional extras include memory search; block copying of memory; the re-locating of programs — changing all JMPs and JSRs — and a slow run — trace feature.

Once a program has been put into memory, a good monitor will allow you to de-bug in Slow mode. In the slow run mode, the program runs much slower than normal but you can stop it at any time and examine the screen, examine the registers, have a look at memory, feed the cat or whatever. This may not sound much, but in some programs where the screen is changed, often the change is far too fast and stopping the program is an ideal way of seeing what has gone wrong.

Some monitors provide a "trace" feature in which every mnemonic is displayed on the screen before being executed. This may go down well with some people but in a delay loop of three mnemonics counting up to 65,000 each time, this can become more of a hindrance than a help.

The big thing that you should find with a monitor is that now you can type in your mnemonics without having to encode them. A typical section of monitor output is shown here:

Monitor works out this			You type in this	
1A2C	A2	08	LDX	#$08
1A2E	A9	00	LDA	#$00
1A30	85	02	STA	$02
1A32	85	03	STA	$03
1A34	06	02	ASL	$02
1A36	26	03	ROL	$03
1A38	06	00	ASL	$00
1A3A	B0	04	BCS	$1A40
1A3C	CA		DEX	
1A3D	D0	F5	BNE	$1A34
1A3F	60		RTS	

Assemblers are very powerful programs, and once used, you will wonder just how you managed before. As an example of an

(continued on page 147)

Figure 2.

ADDRESS	OPCODE	MNEMONIC	COMMENTS
1A2C	A9 00	LDA #$00	SET ANSWER TO Y VALUE
1A2E	85 03	STA $03	
1A30	A5 00	LDA $00	
1A32	85 02	STA $02	
1A34	06 02	ASL $02	ROTATE ANSWER TWICE
1A36	26 03	ROL $03	
1A38	06 02	ASL $02	
1A3A	26 03	ROL $03	
1A3C	18	CLC	ADD Y VALUE
1A3D	A5 02	LDA $02	
1A3F	65 00	ADC $00	
1A41	85 02	STA $02	
1A43	A5 03	LDA $03	
1A45	69 00	ADC #$00	
1A47	85 03	STA $03	
1A49	06 02	ASL $02	ROTATE ANSWER
1A4B	26 03	ROL $03	
1A4D	18	CLC	ADD Y VALUE
1A4E	A5 02	LDA $02	
1A50	65 00	ADC $00	
1A52	85 02	STA $02	
1A54	A5 03	LDA $03	
1A56	69 00	ADC #$00	
1A58	85 03	STA $03	
1A5A	06 02	ASL $02	ROTATE ANSWER
1A5C	26 03	ROL $03	
1A5E	18	CLC	ADD Y VALUE
1A5F	A5 02	LDA $02	
1A61	65 00	ADC $00	
1A63	85 02	STA $02	
1A65	A5 03	LDA $03	
1A67	69 00	ADC #$00	
1A69	85 03	STA $03	
1A6B	06 02	ASL $02	ROTATE ANSWER
1A6D	26 03	ROL $03	
1A6F	60	RTS	RETURN TO BASIC

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(continued from page 145)
assembler ouput, the long multiplication program given later was written on an assembler. Assemblers have many advantages, but the main one has got to be the ability of using variables in a program. At the start of a program, you could write

```
LENGTH = 22
BASE   = 7680
STAR   = $42
```

Having defined the variables you could then write

```
LDA STAR
STA BASE+4*LENGTH+4
```

Instead of

```
LDA $42
STA 7772
```

which is what you would need to put in not having a monitor. Assemblers cannot do anything that cannot be directly translated back to machine code; that is, where X and Y are registers, you could not have:

```
LDA BASE+Y*22+X
```

Normally programs written on an assembler are typed into a word processor, stored as a file and then the assembler loaded and the said file accessed by the assembler as it runs. A common practice is for assemblers to run through the text twice, the first time assigning values to variables and the second actually assembling the text. Such assemblers are know as two-pass assemblers.

This two-pass technique may look all right but one of my programs, with a 90K source code, takes 15 minutes to assemble, whereas with a monitor, there is no actual text assembly — the mnemonics are assembled as they are typed in — so the time taken for the effect of a small change can be seen more or less at a glance. This is one of the main drawbacks of an assembler; one is somewhat cut off from the actual code, even small changes mean a re-assembly and with large programs even a spelling mistake can cause a delay of 15 minutes.

If you can afford them, assemblers in my mind have the edge over monitors, but that is a personal view. Maybe the time factor involved is too long and a monitor may be better for you. It is your choice, but even the most modest of monitors is better than hand coding. ■

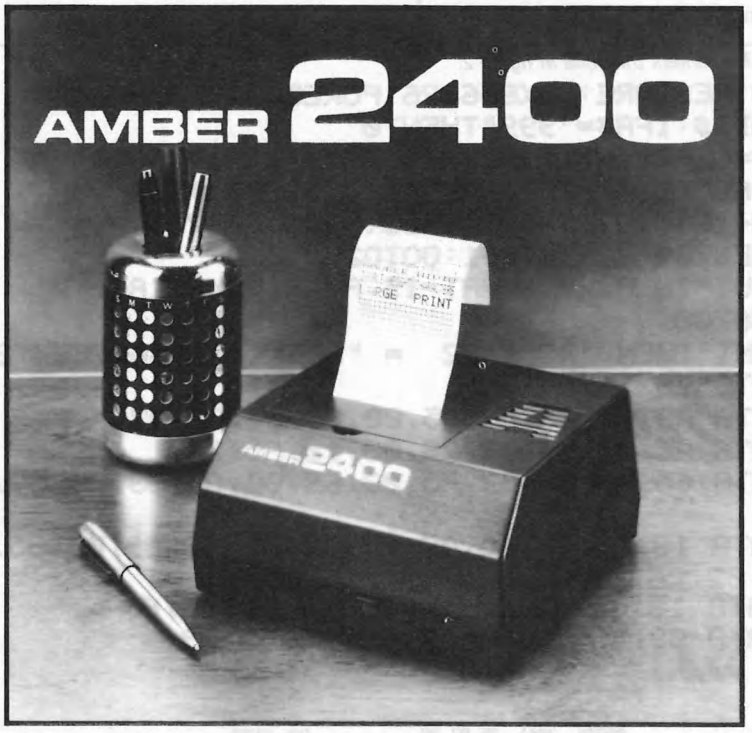
Program 3. This enters the code in figure 2.

```
10 C=0:RESTORE:POKE56,26:POKE52,26
20 READA$:IFA$="999"THEN70
30 D1$=LEFT$(A$,1):D2$=RIGHT$(A$,1)
40 A=(ASC(D1$)-48+((ASC(D1$)>64*7))*16
50 A=A+(ASC(D2$)-48+((ASC(D2$)>64*7))
60 POKE6700+C,A:C=C+1:GOTO20
70 INPUT"IN A*22, WHAT IS A";A:POKE0,A
80 SYS6700
90 PRINT"THEN "A" * 22  = "PEEK(2)+256*PEEK(3)
100 GOTO 70
110 DATA A9,00,85,03,A5,00,85,02,06,02
110 DATA 26,03,06,02,26,03,18,A5,02
120 DATA 65,00,85,02,A5,03,69,00,85,03,06,02,
26,03
130 DATA 18,A5,02,65,00,85,02,A5,03,69,00,85,
03,06,02,26,03
140 DATA 18,A5,02,65,00,85,02,A5,03,69
140 DATA 00,85,03,06,02,26,03,60,999
```

Program 4.

```
LINE# LOC   CODE        LINE

00001  0000              ;A SEMI-COLON IN AN ASSEMBLER IS
00002  0000              ;THE SAME AS A REM STATEMENT IN
00003  0000              ;BASIC
00004  0000              ;
00005  0000              ;
00006  0000              ;
00007  0000              ; ========================
00008  0000              ; ==                    ==
00009  0000              ; == 64 BIT MULTIPLICATION ==
00010  0000              ; ==                    ==
00011  0000              ; ========================
00012  0000              ;
00013  0000              ;
00014  0000                      * = $3000
00015  3000              ;
00016  3000  00          ANS1   .BYT 0          ;RESERVE SPACE
00017  3001  00          ANS2   .BYT 0          ;FOR ANSWER 1,2
00018  3002  00          ANS3   .BYT 0          ;ETC
00019  3003  00          ANS4   .BYT 0
00020  3004  00          ANS5   .BYT 0          ;THE ANSWER WILL BE
00021  3005  00          ANS6   .BYT 0          ;EIGHT BYTES LONG
00022  3006  00          ANS7   .BYT 0          ;HENCE ANS 1-8
00023  3007  00          ANS8   .BYT 0
00024  3008              ;
00025  3008  00          MLTAN1 .BYT 0          ;A FOUR BYTE LONG
00026  3009  00          MLTAN2 .BYT 0          ;MULTIPLICAND
00027  300A  00          MLTAN3 .BYT 0
00028  300B  00          MLTAN4 .BYT 0
00029  300C              ;
00030  300C  00          MLTER1 .BYT 0          ;A FOUR BYTE LONG
00031  300D  00          MLTER2 .BYT 0          ;MULTIPLIER
00032  300E  00          MLTER3 .BYT 0
00033  300F  00          MLTER4 .BYT 0
00034  3010              ;
00035  3010              ;
00036  3010  A9 00       START  LDA #0          ;CLEAR ANSWER
00037  3012  8D 00 30           STA ANS1
00038  3015  8D 01 30           STA ANS2
00039  3018  8D 02 30           STA ANS3
00040  301B  8D 03 30           STA ANS4
00041  301E  8D 04 30           STA ANS5
00042  3021  8D 05 30           STA ANS6
00043  3024  8D 06 30           STA ANS7
00044  3027  8D 07 30           STA ANS8
00045  302A              ;
00046  302A  A2 20              LDX #32        ;MULTIPLIER IS
00047  302C                                     ;32 BITS LONG
00048  302C              ;
00049  302C  0E 00 30    REPEAT ASL ANS1       ;ROTATE ANSWER
00050  302F  2E 01 30           ROL ANS2       ;ONE PLACE LEFT
00051  3032  2E 02 30           ROL ANS3
00052  3035  2E 03 30           ROL ANS4
00053  3038  2E 04 30           ROL ANS5
00054  303B  2E 05 30           ROL ANS6
00055  303E  2E 06 30           ROL ANS7
00056  3041  2E 07 30           ROL ANS8
00057  3044                     ;
00058  3044  0E 0C 30           ASL MLTER1     ;ROTATE
00059  3047  2E 0D 30           ROL MLTER2     ;MULTIPLIER
00060  304A  2E 0E 30           ROL MLTER3
00061  304D  2E 0F 30           ROL MLTER4
00062  3050                     ;
00063  3050  B0 04              BCS ADD1       ;ADD IF C=1
00064  3052                     ;
00065  3052  CA          RETURN DEX            ;FINISHED
00066  3053  D0 D7              BNE REPEAT     ;NO  -GO BACK
00067  3055  60                 RTS            ;YES -END
00068  3056                     ;
00069  3056                     ;
00070  3056  18          ADD1   CLC
00071  3057  AD 00 30           LDA ANS1
00072  305A  6D 08 30           ADC MLTAN1
00073  305D  8D 00 30           STA ANS1       ; ANSWER
00074  3060  AD 01 30           LDA ANS2       ;
00075  3063  6D 09 30           ADC MLTAN2     ;  =
00076  3066  8D 01 30           STA ANS2       ;
00077  3069  AD 02 30           LDA ANS3       ; ANSWER
00078  306C  6D 0A 30           ADC MLTAN3     ;
00079  306F  8D 02 30           STA ANS3       ;  +
00080  3072  AD 03 30           LDA ANS4       ;
00081  3075  6D 0B 30           ADC MLTAN4     ;MULTIPLICAND
00082  3078  8D 03 30           STA ANS4
00083  307B  AD 04 30           LDA ANS5
00084  307E  69 00              ADC #0
00085  3080  8D 04 30           STA ANS5
00086  3083  AD 05 30           LDA ANS6
00087  3086  69 00              ADC #0
00088  3088  8D 05 30           STA ANS6
00089  308B  AD 06 30           LDA ANS7
00090  308E  69 00              ADC #0
00091  3090  8D 06 30           STA ANS7
00092  3093  AD 07 30           LDA ANS8
00093  3096  69 00              ADC #0
00094  3098  8D 07 30           STA ANS8
00095  309B  4C 52 30           JMP RETURN
00096  309E                     ;
00097  309E                     ;
00098  309E                     ;
00099  309E                     .END           ;END OF ASSEMBLY

ERRORS = 00000

SYMBOL TABLE

SYMBOL VALUE
 ADD1     3056    ANS1     3000    ANS2     3001    ANS3     3002
 ANS4     3003    ANS5     3004    ANS6     3005    ANS7     3006


SYMBOL TABLE

SYMBOL VALUE
 ANS8     3007    MLTAN1   3008    MLTAN2   3009    MLTAN3   300A
 MLTAN4   300B    MLTER1   300C    MLTER2   300D    MLTER3   300E
 MLTER4   300F    REPEAT   302C    RETURN   3052    START    3010

END OF ASSEMBLY

MULTIPLY1......PAGE 0002

LINE# LOC   CODE        LINE
```

PRINT OUT



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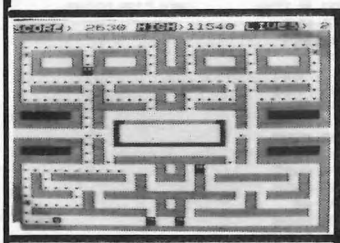

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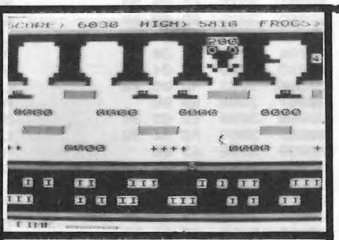

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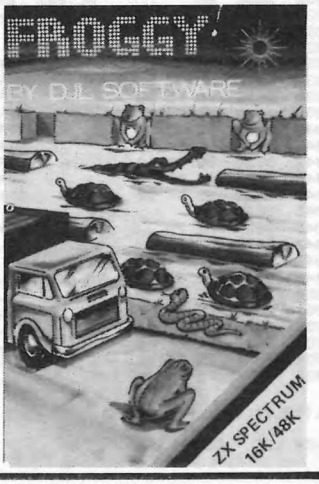

RESPONSE FRAME

Do you have a problem? Your manual is incomprehensible or you just cannot get the hang of that programming trick you tried — whatever it is, Tim Hartnell will do his best to answer your queries. Please include only one question per letter and mark them "Response Frame".

MONSTER KILL

■I won a 16K ZX-81 and am writing a program which incorporates a routine to kill a monster. To kill the monster, you should have to press a key four times. In my program, I have set a counter so that when the key is pressed, using Inkey$, the program jumps to a line number and a counter is increased by one. Then the program jumps back to the main part of the program where the key has to be pressed again. My problem is that I can just keep the key pressed down and the program, after increasing the counter by one, returns to the main program, finds the key already pressed down and returns to the counter routine again. This continues as long as I keep the key depressed. When the counter has reached four, as I said, the monster is killed. Could you tell me of a way to stop the key from auto-repeating once it has been pressed so that it has to be pressed, then released and re-pressed, instead of just keeping it depressed all the time.

Jonathan Church,
Ashby-de-la-Zouch,
Leicestershire.

THE EASIEST way to do this — and this routine will work on most computers which demand Inkey$ responses, and not just on the ZX-81 — is to proceed as follows. Assuming you must press the K key to kill the monster, and the subroutine which increments the counter starts at line 1000, this line would detect the key-press:

```
100 IF INKEY$ = "K" THEN GOSUB
    1000
```

the next line should then be:

```
110 IF INKEY$ <> "" THEN GOTO 110
```

As you can see, this will ensure that the program stops on line 110 until you take your finger off, before proceeding.

MAKING A DIN

■In a recent issue of *Your Computer* — April 1983 — there was a question regarding the use of a Phillips EL-3302 tape recorder with a Spectrum. I am at present using such a tape recorder with my 16K Spectrum. I made up two leads, one with a female jack plug in one end and a two-pin DIN plug on the other end to fit into the external speaker socket. The second lead has a female jack on one end and a five-pin DIN plug to fit into the input socket. These leads, fitted to the correct outlets from the Spectrum, I have found most satsifactory.

B Riley,
Tilbury.

THANKS FOR your letter. There have been many questions raised regarding the use of DIN-output-input tape recorders with Sinclair and other computers, therefore, we have printed your letter in full in the hope that it will prove useful to those who have raised these problems.

SWEET MUSIC

■I own a 16K Spectrum and for some weeks have been trying unsuccessfully to turn it into a synthesiser, where the note sounds continuously while a key is pressed. Can you suggest a way of getting around this problem?

Colin Tombeur,
Andover,
Hampshire.

UNFORTUNATELY, the way the Spectrum Basic has been written ensures that the program actually stops while the Beep is sounding. Therefore, you really have to write you program so that each note is a predetermined length. The simplest — but by no means completely satisfactory — way to get around this is to get the computer to produce a very short note, so holding down the key will produce a series of notes.

POWER PACK

■I have a question about my rights regarding damage. I recently bought a rechargeable battery pack from a firm, and on connecting it according to the instructions I damaged not only the battery pack, but my Spectrum and its power supply unit.

These will have to be returned for repair, but I have not yet done this because I am not sure what the procedure would be in case of dispute, such as the battery firm claiming it was not their fault. What is my best course of action?

M R Carter,
Lusaka,
Angola.

YOUR FIRST step should be to contact the firm that supplied the battery pack, tell them exactly what you did, and what happened. Secondly, you should read the instructions and disclaimer which came with the battery pack, as this should make it fairly clear whether or not the firm will accept liability for problems allegedly caused by their equipment when used in accordance with their directions. It is impossible to say anything more without having specific details. However, I cannot imagine how the battery supply company could have anticipated — and I cannot think how or why you have done it — you in some way linking up your battery, recharging pack, Spectrum and power supply. They may well take the view that your action was outside the reasonable conditions covered by their instructions.

RAM JAM

■Having owned a 16K Spectrum since Christmas, along with a printer, and having seen 48K Spectrums at school and their software I have been interested in upgrading.

Bearing in mind the cost, and the possible difficulty of a DIY fitting, how would you suggest I increase my RAM?

L J Ward,
Liss,
Hertfordshire.

AS YOU may have read, Sinclair Research is now offering a memory upgrade for the Spectrum, starting from those who ordered their computers first. As yours is a relatively recent one, it may be some time before you are offered the upgrade. The Sinclair Research upgrade is not the cheapest, but you need have no doubts about the suitability of the chips used, nor about invalidating your warranty. I have not heard any bad reports from Spectrum owners who have upgraded their memories with products from other suppliers. However, I would suggest that if the price is not too much of a problem, and you can afford to wait, you use the Sinclair Research service. Incidentally, other companies who advertise in *Your Computer* offer a fitting service as well, so you do not have to be worried about the DIY aspect.

MIND HOW YOU GO

■I am thinking of starting a software club. Would I be able to use programs from magazines? Would I be able to use company software and make copies of the originals in care of wear?

Iain Donaldson,
Linlithgow,
West Lothian.

THE ANSWER to both questions is "No". In nearly all cases, copyright of a program published in a magazine is held by the publisher, so you are unable to do anything with published programs except for your own private use. Copying a manufactured program is an infringement of copyright, and is in fact straight theft, as you are depriving the company and the programmer of the royalties they have earned. Just as you could not copy a music cassette, and then try to sell your copies, you cannot copy a program cassette. Further to all this, the whole issue of software libraries is under question. Many people feel that they are in large measure a very simple way of ensuring people have access to software at low cost which they can then copy to save them having to buy the cassette. Again, this is theft.

ORIC KEYBOARD

■I am waiting for the delivery of my Oric-1 16K. Since the Oric has excellent sound facilities, I would like to use it for a synthesiser as well as a microcomputer.

I would like to know how to add a musical keyboard to it so I could play live music. Would I need a special interface? Could I use a keyboard like the ones advertised in electronics magazines — such as the ones distributed by Maplins?

Darrin Pascoe,
Christchurch,
New Zealand.

YOU ARE right in your comments on the quality of the sound output of the Oric-1. Connecting up a music keyboard is as simple as connecting up an extension keyboard for general computer use. Your main problem — and it is not a very major one — will be in writing a program to enable the computer to convert the key-presses into sound. When you wish to use the computer as a musical instrument, you will need to load the relevant program, and have it running while you "play" the Oric. Speed of response in this case will be critical, so you will have to write the program carefully.

SPEAK TO ME

■I read in my *Programmers' Reference Guide* for the Vic-20 computer that the cartridges of the Scott Adams Adventure series — The Count, Voodoo Castle, Mission Impossible — have been encoded to speak to you if your Vic-20 is linked to a Votrax Type-n-talk unit. Could you confirm that this is true? If so, I am sure many Vic owners would find this of interest. If it is ture, could you tell me where I could purchase the speech synthesiser?

Derek Williamson,
East Kilbride.

THE GUIDE is correct. You can get encoded versions of the programs you mention which will speak to you as you play. I have been unable to track down the U.K. importer of the synthesiser, but it is made and distributed by Votrax, 500 Stephenson Highway, Troy, MI, 48084, U.S.A. Telephone 313-588 0341. ■

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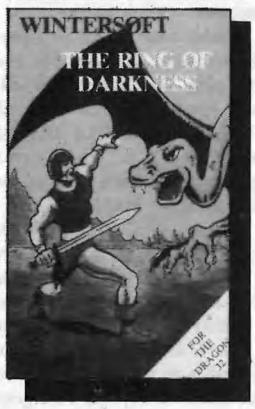

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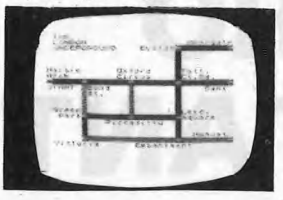
(ZX Spectrum – 48K)
by Douglas Elliott



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Dangerman

Mark Carne,
Church Enstone,
Oxford.

ZX-81

THE OBJECT of this original game is to run around a building site, hammering in nails. The nails are represented by full stops and are hammered into place by positioning asterisks over them. If you have hit the nail on the head, the full stop will turn into a comma.

The man earning the danger money — that is you — is somewhat hampered by the near gale-force winds which rage across the building site. The strength of these gales is indicated on the bottom line by a number in the Beaufort scale.

You, the intrepid little builder, can withstand a gale of up to force 7. If the scale reaches 8, the builder is blown to his right: if the scale reaches 9, the builder is blown two spaces to his right.

The cursor keys move the builder in the four normal directions: 6 up, 7 down, 5 left, 8 right. You can counteract a wind blowing force 8 by pressing the 5 key; if the wind reaches force 9, start praying.

If the builder has the misfortune to lose his footing and is blown over the edge, or falls off a ladder or a girder, the poor man will fall to be compressed in a horizontal plane.

The CHR$128 characters represent the building-site girders, CHR$14 the ladders, and CHR$136 at the right-hand end of the screen the moving girder.

This girder acts as a lift for the builder to reach the top-level without having to cross the screen and climb the ladders at the left-hand end. If the builder falls off this, he will again be falling to his doom. Here is a list of the variables used in the program:

LL is the player's level
P is the start of the display file
DE is the number of nails hammered
A is the vertical position of the builder
B is the horizontal position of the builder
A$ contains the 30 CHR$128s for printing girders
D$ contains the 30 CHR$27s for printing the nails
B$ colon is the CHR$ 14 for printing the ladders
L$ holds the two CHR$136s — the falling/rising girder
L1 is the vertical position of the falling/rising girder
L2 is the horizontal position of the falling/rising girder
I is the control variable for all For-To loops
U is the last USR number, used for plotting over the builder's last position denoted by an asterisk
N is the direction of the falling/rising girder
W is the wind strength
S is the score — given in pounds at the end of the game
T is the position of the next H in "Ahhhh . . ."

The builder does all this for the money. Even builders have to eat. For every nail he hammers while there is a wind blowing he gets paid the amount in pounds sterling of the wind speed — force 5 means £5 per nail, and force 9 will pay £9 while he slides towards his doom, providing he is hammering nails on the way.

If there is no wind he does not get paid even if he is hammering nails. The score is shown at the end of the game and the money is forwarded to his next of kin.

Do not climb a ladder or use the falling/rising girder while there is a force 7 or more gale blowing. If a force 8 or 9 gale is blowing, you will be swept off the ladders and sometimes even the falling/rising girder.

```
   1 REM E:RND7,"TAN
  10 LET LL=1
  20 LET P=PEEK 16396+256*PEEK 1
6397
  30 POKE 16418,1
  40 CLS
  50 LET DE=0
  90 RAND
 100 LET A=20
 110 LET B=INT (RND*31)
 130 LET A$="
"
 135 LET D$="..................
............"
 140 LET B$=":"
 150 PRINT AT 21,0;A$;AT 20,0;D$
 155 PRINT AT A,B;"*"
 160 PRINT AT 15,5;A$( TO 10);AT
 15,20;A$( TO 10);AT 14,5;D$( TO
 10);AT 14,20;D$( TO 10)
 170 PRINT AT 16,12;A$( TO 10);A
T 17,12;D$( TO 10)
 180 PRINT AT 10,5;A$( TO 25);AT
 9,5;D$( TO 25)
 190 PRINT AT 5,10;A$( TO 20);AT
 4,10;D$( TO 20)
 200 PRINT AT 5,17;" "
 210 PRINT AT 1,13;A$( TO 12);AT
 0,13;D$( TO 12)
 220 LET L$="
"
 230 LET L1=5
 240 LET L2=29
 250 PRINT AT L1,L2;L$
 260 REM DRAW LADDERS
 270 FOR I=10 TO 20
 280 PRINT AT I,5;B$
 290 NEXT I
 300 FOR I=5 TO 9
 310 PRINT AT I,10;B$;AT I,17;B$
 320 NEXT I
 330 FOR I=1 TO 4
 340 PRINT AT I,13;B$;AT I,24;B$
 350 NEXT I
 360 FOR I=18 TO 20
 370 PRINT AT I,12;B$;AT I,21;B$
 380 NEXT I
 390 FOR I=14 TO 17
 400 PRINT AT I,14;B$;AT I,19;B$
 410 NEXT I
 420 LET U=26
 430 LET N=1
 440 IF LL=1 THEN LET S=0
 450 LET W=INT (RND*10)
 455 PRINT AT 22,6;"WIND:"
 460 POKE P+740,W+26
 700 IF RND>.4 THEN LET W=W+(INT
 (RND*3)-1)
 705 LET W=W+(W<0)-(W>9)
 707 POKE P+740,W+26
 710 PRINT AT A,B;CHR$ U;AT L1,L
2;"
"
 712 IF W=8 THEN LET B=B+1
 715 IF W=9 THEN LET B=B+2
 720 LET L1=L1+N
 730 PRINT AT L1,L2;L$
 735 IF U=136 THEN LET A=A+N
 740 IF L1=20 THEN LET N=-1
 750 IF L1=4 THEN LET N=1
 760 LET A=A+(INKEY$="5")-(INKEY
$="7")
 770 LET B=B+(INKEY$="8")-(INKEY
$="5")
 772 IF A<0 THEN LET A=0
 774 IF B<0 THEN LET B=0
 776 IF B>31 THEN LET B=31
 780 PRINT AT A,B;
 790 LET U=USR 16514
 800 IF U=27 THEN LET S=S+W
 805 IF U=27 THEN LET DE=DE+1
 810 IF U=128 OR U=0 THEN GOTO 1
500
 825 IF U=27 THEN LET U=26
 830 PRINT "*"
 840 IF DE>100 THEN GOTO 2000
 850 GOTO 700
1500 PRINT AT 21,0;"
"
1501 LET T=1
1505 FOR I=A TO 20
1510 PRINT AT I,B;"*";AT I-1,B;"
"
1515 PRINT AT 21,T;"
"
1517 LET T=T+1
1520 NEXT I
1530 PRINT AT 20,B-3;"<<<*>>>"
1540 PRINT AT 21,B-3;"  SPLAT  "
1550 PRINT AT 0,0;"A GRAND"
1560 PRINT "WAGE"
1570 PRINT "OF:£";S
1580 POKE 16418,0
1590 STOP
2000 LET LL=LL+1
2010 PRINT "LEVEL:";LL
2020 FOR I=1 TO 20
2030 NEXT I
2040 GOTO 20
```

Omega Invaders

Andrew Caple,
Bury,
Lancashire.

SPECTRUM

THIS PROGRAM was written on a 16K Spectrum. The control keys used are:

Q — left
E — right
0 — fire

On running the program the colours will be set and the titles appear. In the middle of the design the flashing message:

COMPILING

appears which means the computer is putting the machine-code bytes into their proper places. This is only done once in the program so do not worry about having to wait each time you want a game. Resetting before a game is very fast once compiled.

Once this process is completed the screen is cleared and a prompt appears. This prompt is for the level of skill and will accept values from 0 to 6. It only affects the speed of the game — 0 is the fastest and 6 is the slowest. Once you have typed in your level, press Enter and the game will start.

You may fire and move at the same time. What you cannot do is go in two directions at once. The base will not stop at the side of the screen as in on the arcade version of Space Invaders but reappears on the opposite end of the line.

The best way of entering the data is to get a friend to read out the hex digits for you while you type them in. Once you have typed in the listing check it line by line then save it. Once you have a version that works resave it with the statement

SAVE "INVADERS" LINE 1

This will give automatic running on loading.

```
   1 CLEAR 29900: INK 3: BRIGHT
1: PAPER 0: BORDER 0: CLS : PLOT
 128,0: DRAW OVER 1,0,155,2771+P
I
   2 INK 7: PRINT AT 0,0;"OMEGA
INVADERS @-ANDREW CAPLE'83": LET
B$="5667000566700056670005667":
PRINT AT 11,11; FLASH 1;"COMPIL
ING!"
   3 FOR F=0 TO 31: POKE 30208+F
,10: POKE 30240+F,14: POKE 30944
```

(continued on next page)

(continued from previous page)

```
+F,14: NEXT F: FOR F=30272 TO 30
943: POKE F,10: NEXT F
   4 FOR F=1 TO 25: POKE 30755+F
,VAL B$(F)+10: NEXT F
   5 FOR G=1 TO 3: FOR F=1 TO 25
: IF VAL B$(F)<>0 THEN POKE 3075
5+F+32*G,16
   6 NEXT F: NEXT G
   7 POKE 30914,16
   8 FOR F=1 TO 79: POKE 32512+F
,PEEK (15744+F): NEXT F
   9 FOR f=20 TO 22: POKE 30265+
f,f: NEXT f
  10 LET A=10: LET B=11: LET C=1
2: LET D=13: LET E=14: LET F=15:
 LET A$="#"
  20 IF A$="#" THEN READ ADD: LE
T A$=""
  21 IF ADD=0 THEN GO TO 400
  30 IF A$="" THEN READ A$
  40 POKE 23692,255: POKE ADD,16
*VAL A$(1)+VAL A$(2)
  50 LET ADD=ADD+1: LET A$=A$(3
TO ): GO TO 20
 100 DATA 31488,"2A637B7EFE05280
92B7CFE7B20F50E01C922637B7CFE7E2
0087DFEBF38030E02C906907EFE0B201
148E53E0ACDC07AE1E5233E08CDC07AE
1412B10E70E002A637B232237B7BC9#"
 110 DATA 31424,"77F55D7CD67C678
787CBF757F187878726 7F6F06087E122
31410FAC9#"
 120 DATA 31516,"000000107D00C27
E000000000000000004D7C#"
 130 DATA 31560,"2A667B7EFE12280
83E0432857B3612C9E53E0ACDC07AE10
1FEF8ED78CB472001 2DC8572001 2C7DE
61FC6C06F3E122285 7BCDC07AC9#"
 140 DATA 31232,"3A667BFE0020190
1FEEFED78CB47C03E0532857B2A867B2
2697B3E0132867BC92A697B7EFE0D200
7E53E0ACDC07AE101E0FF097EFE0A200
922897B3E0DCDC07AC9FE0B200AE5"
 150 DATA "218F7BCDE07BE11804FE0
E28053E0ACDC07AAF32867BC9#"
 160 DATA 31104,"3A607BFE0020222
A837B3A785CE60E874F0600A7ED42477
EFE0B200922817B3E0132807BC92310E
FC92A817B7EFE0C2007E53E0ACDC07AE
101200009 7EFE132804"
 170 DATA "FE0A200922817B3E0CCDC
07AC9FE0F38053E13CDC07A3E0032807
BC9#"
 180 DATA 31680,"21007C7EE5CDC07
AE1233E7FBCC618F3#"
 190 DATA 31712,"7E3CFE0A2005360
02818F5771120002 10002CDB503C9#"
 200 DATA 31072,"118C7B211C7C060
41AE5D5C5CDC07AC1D1E1132310F2C9#
"
 210 DATA 31056,"21617C06403 60B2
32310FAC9#"
 220 DATA 31040,"21007611007C010
003EDB0C9#"
 230 DATA 31008,"F316003E100603C
542D3FEEF1010FEC110F5143E508A20E
BFBC9#"
 240 DATA 30050,"3A907BFE0525033
C180BCD0075CD007B793285 7BAF32907
BCD8079CD807ACD007ACD60793A857BF
E00280FFE012005CD50791806FE08C0C
D2079AF32857B0620C5068010FEC110F
818B6#"
 250 DATA 29952,"2A917B05037EFE0
A200B218E7BCDE07B215D7C180E2310E
D2A917B2B7DFE3F20022E5DE52A917B0
603E5C53E0ACDC07AC1E12310F4E1229
17B3E140603E5"
 260 DATA "C5F5CDC07AF1C1E13C231
0F3C9#"
 270 DATA 32592,"00000000000000
0187E99BDD624E7001806186018061 80
000103854101010000000CCCC3333000
01F3F7FFFFFFFFFFFFFFFFFFFFFFFF
FF8FCFEFFFFFFFFFFF"
 280 DATA "0000187EFFFFFFFF00303
606D8F9FFFF00071C1C3F3F141C00FF9
999FFFF000000E03838FCFC2838#"
 290 DATA 31664,"21937511807501 1
300EDB0C9#"
 300 DATA 31535,"000000107D00C27
E000000000000000004D7C#"
 310 DATA 0
 400 LET C$="0000": BORDER 0: BR
IGHT 1: INK 7: PAPER 0: CLS
 410 INPUT "LEVEL ";L: LET L=INT
L*4+16
 420 IF L<0 OR L>41 THEN PRINT :
PRINT "ERROR": GO TO 410
 430 POKE 30143,L
 440 CLS : LET D$="772345623456 2
345644444": FOR F=1 TO LEN D$: P
RINT INK VAL D$(F);"
                    ": NEXT F
 450 LET L=USR 31664: LET L=USR
31040: LET L=USR 31056: LET L=US
R 31680
 460 INK 0: PAPER 7: PRINT AT 0,
0;"HIGH SCORE=";C$;"          SCORE
=0000"
 470 INK 7: PAPER 0: LET L=USR 3
0080: BEEP 1,-30
 480 LET B$="": FOR F=31628 TO 3
1631: LET B$=B$+STR$ PEEK F: NEX
T F
 490 PRINT AT 10,11;"GAME OVER"
 500 IF VAL B$>VAL C$ THEN PRINT
AT 12,9; FLASH 1;"NEW HIGH SCOR
E": LET C$=B$
 510 IF INKEY$="" THEN GO TO 510
 520 GO TO 410
```

Animal magic

R Spink,
Frecheville,
Sheffield.

BBC

MY ANIMALS program for the BBC Micro is a simple example of artificial intelligence. You think of an animal and answer the questions asked by the computer until it finds an animal, which should be the one you are thinking of.

If it is not, you will be asked for the name of the animal and for a suitable question if it ever reaches to this point again. So as you can see the program learns. The more it is used, the more animals it will know.

The data can be saved on cassette and loaded when the program is run again. When the program is run for the first time it asks you for a suitable initial question. These should be of the form:

Do you have . . . ?
Are you . . . ?

For example: "Do you have four legs?" It will ask for an animal whether the answer is yes or no. For example, for the last question dog for yes, sparrow for no. From now on the program is learning about animals.

```
  5REM FOR £ READ HASH CHARACTER
 10MODE7
 20DIM Q$(250),Y%(250),N%(250),A$(300)
 30CLS
 40PRINT ''CHR$141CHR$129"    Animal guessing game"
 50PRINTCHR$141CHR$129"    Animal guessing game"
 60VDU28,0,23,39,5
 70PRINT '"Is there a data file to use ? ";
 80REPEAT
 90ANS$=GET$
100UNTIL ANS$="Y" OR ANS$="y" OR ANS$="N" OR ANS$="n"
110PRINT ANS$
120IF ANS$="Y" OR ANS$="y" THEN PROCREADTAPE ELSE PROCINIT
130REPEAT
140PROCSCORE
150PRINT ''"Are you thinking of an animal ? ";
160REPEAT
170ANS$=GET$
180UNTIL ANS$="Y" OR ANS$="y" OR ANS$="N" OR ANS$="n"
190PRINT ANS$
200IF ANS$="N" OR ANS$="n" THEN PROCEND : END
210LREC=1
220REPEAT
230IREC=LREC
240REPEAT
250PRINT '@$(IREC);" ? ";
260LASTANS$=GET$
270UNTIL LASTANS$="Y" OR LASTANS$="y" OR LASTANS$="N" OR LASTANS$="n"
280PRINT LASTANS$
290IF LASTANS$="Y" OR LASTANS$="y" THEN LREC=Y%(IREC)
300IF LASTANS$="N" OR LASTANS$="n" THEN LREC=N%(IREC)
310UNTIL LREC < 1
320REM Animal found ************
330PRINT '"Are you a "CHR$129;A$(-LREC);" ? ";
340REPEAT
350ANS$=GET$
360UNTIL ANS$="Y" OR ANS$="y" OR ANS$="N" OR ANS$="n"
370PRINT ANS$
380IF ANS$="Y" OR ANS$="y" THEN PROCWIN
390IF ANS$="N" OR ANS$="n" THEN PROCLOSE
400UNTIL FALSE
410DEFPROCREADTAPE
420PRINT "Align the Animals data tape "'"Press any key when ready"
430ANS$=GET$
440X=OPENIN("ANDATA")
```

(continued on page 157)

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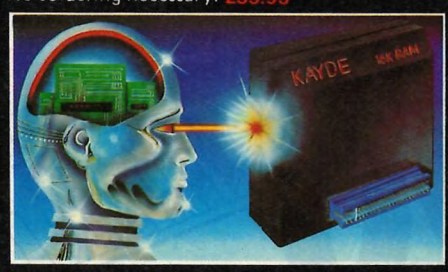

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(continued from page 154)

```
450INPUT£X,QUESTIONS,ANIMALS,WIN,LOSE
460FORI=1TOQUESTIONS
470INPUT£X,Q$(I),Y%(I),N%(I)
480NEXT
490FORI=1TOANIMALS
500INPUT£X,A$(I)
510NEXT
520CLOSE£X
530ENDPROC
540DEFPROCINIT
550WIN=0
560LOSE=0
570INPUT "Enter the first question  "'Q$(1)
580INPUT "Enter the animal if the answer is YES "'A$(1)
590INPUT "Enter the animal if the answer is NO "'A$(2)
600QUESTIONS=1
610Y%(1)=-1
620N%(1)=-2
630ANIMALS=2
640ENDPROC
650DEFPROCWIN
660PRINT ''CHR$131CHR$136"I WIN !!!"
670WIN=WIN+1
680ENDPROC
690DEFPROCEND
700PRINT"Do you want to save the data ? ";
710ANS$=GET$
720PRINT ANS$
730IF ANS$="N" OR ANS$="n" THEN ENDPROC
740PRINT "Align the Animals data tape "'"Press any key when ready"
750ANS$=GET$
760X=OPENOUT("ANDATA")
770PRINT£X,QUESTIONS,ANIMALS,WIN,LOSE
780FORI=1TOQUESTIONS
790PRINT£X,Q$(I),Y%(I),N%(I)
800NEXT
810FORI=1TOANIMALS
820PRINT£X,A$(I)
830NEXT
840CLOSE£X
850PRINT "Saved Ok"
860ENDPROC
870DEFPROCLOSE
880QUESTIONS=QUESTIONS+1
890LOSE=LOSE+1
900ANIMALS=ANIMALS+1
910INPUT "Ok, I give up . What animal are you ?"'A$(ANIMALS)
920PRINT'"What question could I ask to tell a "';A$(-LREC);" from a ";A$(ANIMA
LS);" ? "
930INPUT""Q$(QUESTIONS)
940PRINT "What would be the answer for ";A$(ANIMALS);" ? ";
950REPEAT
960ANS$=GET$
970UNTIL ANS$="Y" OR ANS$="y" OR ANS$="N" OR ANS$="n"
980PRINT ANS$
990IF ANS$="Y" OR ANS$="y" THEN Y%(QUESTIONS)=-ANIMALS:N%(QUESTIONS)=LREC
1000IF ANS$="N" OR ANS$="n" THEN Y%(QUESTIONS)=LREC:N%(QUESTIONS)=-ANIMALS
1010IF LASTANS$="N" OR LASTANS$="n"THENN%(IREC)=QUESTIONS
1020IF LASTANS$="Y" OR LASTANS$="y"THENY%(IREC)=QUESTIONS
1030ENDPROC
1040DEFPROCSCORE
1050PRINT''CHR$130 "I know ";ANIMALS;" animals."
1060PRINTCHR$131 "After playing ";WIN+LOSE;" games"
1070PRINTCHR$133 "I have won ";WIN;" games "'CHR$134"and have lost ";LOSE
1080ENDPROC
```

Race-track

P Nangle,
Formby,
Liverpool.

VIC-20

THIS GAMES program for the unexpanded Vic-20 computer makes use of both user-defined and multicolour mode graphics. The game runs just within the memory available once 512 bytes have been taken over from Basic to hold the user-definable graphics.

When running, the program uses up all but about 20 bytes — so it is essential that you keep to the format of the printed program.

The idea of the game is to drive your racing car around a difficult track in the shortest time. If the car crashes, it explodes. This is inconvenient because you lose time, a significant amount of debris is left on the track and you must start the lap again.

If the track becomes blocked by debris it is usually possible to complete the lap by taking another route since it is only necessary to pass the two arrows to score a lap.

Read-outs of time taken, laps completed and the number of the car are given. The time is only updated when the car is not in motion or when a crash takes place — the crash time is shown. This speeds up the animation and is no serious disadvantage because when the car is being driven, the player cannot look at the time or he will crash.

The game ends after three laps, three minutes or 10 crashes and a score is given. At any stage the game may be restarted by using key f7.

I have found it possible to complete the game in under one minute, however, this requires much practice and the beginner could find it difficult to complete even one lap.

Reverse-field characters will not be printed. The use of the

RVS ON

in printed statements means that the Vic uses its internally-stored ROM characters when set to user-defined characters. Hence down-loading the original character set is not necessary.

POKE K,9

sets up multicolour mode graphics in green.

SYS 65234

performs Restore as if run-stop and restore had been pressed.

If line 330 is changed to:

GET A$: POKE 652,1

the game becomes much harder as the delay before key repeat is reduced. This is only for experts.

If the Vic prints rubbish on the screen and the game stops, then the message can be read by putting your cursor over the letters individually. Alternatively you will find that

POKE 36869,240

causes a return to original character set. If the game continues then it just means that you have omitted a RVS On from a print statement somewhere.

```
10 POKE52,28:POKE56,28:CLR:POKE650,128:PRINTCHR$(8)
20 GOSUB700:GOSUB710:POKESC,8:PRINT"        RACE TRACK"
30 FORI=7168TO7231:READT:POKEI,T:NEXTI
40 FORI=7424TO7431:POKEI,0:NEXTI:FORT=1TO200:NEXTT
50 PRINT"MOVEMENT KEYS":PRINT"L":POKESC-10,255
60 PRINT"A + S":PRINT"I <"
80 PRINT"F7= RESTART"
90 PRINT"        PRESS A KEY"
100 GETA$:IFA$=""THEN100
110 PRINT"":POKESC,13:POKEV,5*16:K=646:LC=0
201 POKEK,9:PRINTTAB(2)"DDDDDDDDDDDDDDDD"
202 PRINTTAB(2)"K";:POKEK,9:PRINT"DTIME";:POKEK,9:PRINT"DD"TAB(17)"DDD"
203 PRINTTAB(2)"DD    D"TAB(18)"D"
204 PRINTTAB(2)"DDDDDDD  DDDD"
205 PRINTTAB(2)"DDLAPS";:POKEK,9:PRINT"D    DDDD"TAB(20)" D"
206 PRINT"  DD    DD      DDDDDDD"
207 PRINT"  DDDDDDDDD"
208 PRINTTAB(2)"DDCAR ";:POKEK,9:PRINT"DDDDD"
209 PRINTTAB(3)"D   1";:POKEK,9:PRINT"DDDDDDDDDDDD"
210 PRINT"    DDDDDD      DDDD"
211 PRINT"D       DDD     DDDD"
212 PRINT"DDD     DD   D   DDDD"
213 PRINT"DDDDD  DD  DDD  DDDD"
214 PRINT"DDDD   DD  DDD  DDDD"
215 PRINT"DDD   DDD  DDD  DDDD"
216 PRINT"DD   DDDD  DDD  DDDD"
217 PRINT"D"TAB(4)"DDDDD  DDD  DDDD"
218 PRINTTAB(3)"DDDDDD  DDD  DDDD"
219 PRINTTAB(2)"DDDDDD   DDD   DD>":POKEK,9
220 PRINTTAB(11)"DDD"
221 PRINTTAB(10)"DDDD"
230 POKEV,PEEK(V)AND240OR15:GOSUB700:GOSUB710
240 POKEX,C:POKEX+CO,1:NC=1
250 FORCD=5TO1STEP-1:T=TI
260 PRINT""CD:POKES3,220:POKES3,0
270 IFTI-T<60THEN270
280 NEXTCD:TI$="000000":POKE198,0
290 GOSUB700:GOSUB710:POKES1,128:POKES2,128:POKE198,0:POKEV,PEEK(V)AND240OR5
300 Y=X+DX:POKEY+CO,1:POKEY,C:IFDX<>0THENPOKEX,32
310 X=Y:DX=0:IFX=8140ORX=8141THENL=1
320 IFL=1ANDVP=3ANDHP<3THENLC=LC+1:PRINT""LC:L=0:IFLC=3THENT$=T
I$:GOTO550
330 GETA$
340 IFPEEK(197)=64THENPRINT""MID$(TI$,4,1)":"RIGHT$(TI$,2)
350 IFVAL(TI$)>000259THENT$=TI$:GOTO550
360 IFA$=""THEN300
361 IFA$=","THEN410
362 IFA$="L"THEN420
363 IFA$="A"THEN430
364 IFA$="S"THEN440
365 IFASC(A$)=136THENPOKES2,0:POKES1,0:GOTO110
370 GOTO330
410 IFPEEK(X+22)=32ANDVP<22THENDX=+22:VP=VP+1:C=1:GOTO300
411 GOTO500
420 IFPEEK(X-22)=32ANDVP>0THENDX=-22:VP=VP-1:C=0:GOTO300
421 GOTO500
430 IFPEEK(X-1)=32ANDHP>0THENDX=-1:HP=HP-1:C=2:GOTO300
431 GOTO500
440 IFPEEK(X+1)=32ANDHP<21THENDX=+1:HP=HP+1:C=3:GOTO300
441 GOTO500
500 POKES4,150:POKESC,12:POKEV,4*16:T$=TI$
510 PRINT""MID$(TI$,4,1)":"RIGHT$(TI$,2):POKES1,0:POKES2,0
520 FORI=15TO0STEP-1:POKEV,PEEK(V)AND240ORI:POKEX,6:POKEX+CO,4
530 FORT=1TO100:NEXTT:POKEX+CO,7:NEXTI:POKES4,0:POKEV,PEEK(V)AND240OR0:POKEX+CO
1
540 NC=NC+1:POKESC,13:POKEV,5*16
541 IFNC<10THENPRINT"  "NC
542 IFNC=10THENPRINT" "NC
543 IFNC>10THEN550
```

(continued on page 161)

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(continued from page 157)

```
545 POKEX,5:FORI=1TO500:NEXT:GOTO290
550 PRINT"[illegible]GAME   OVER":POKE36874,0:POKE36875,0:FORT=1TO2000:NEXTT
600 PRINT"[illegible]SCORE":PRINT"[illegible]"
610 PRINT"[illegible]YOU COMPLETED"LC"LAPS  IN "MID$(T$,4,1)" MINUTES "RIGHT$
(T$,2)" SECS";
620 PRINT"[illegible]AND CRASHED"NC-1"CARS"
630 PRINT"[illegible]HIT F7 TO PLAY":PRINT"[illegible]HIT F1 TO END"
640 GETA$:IFA$=""THEN640
650 IFASC(A$)=136THEN110
660 IFASC(A$)=133THEN680
670 GOTO640
680 PRINT"[illegible]THE END.":FORT=1TO1000:NEXT:SYS65234
700 X=7746:CO=30720:DX=0:C=0:VP=3:HP=0:L=0:RETURN
710 S1=36874:S2=S1+1:S3=S2+1:S4=S3+1:V=S4+1:SC=V+1:RETURN
10000 DATA24,90,126,90,24,90,126,66,66,126,90,24,90,126,90,24
10001 DATA0,119,34,254,254,34,119,0,0,238,68,127,127,68,238,0
10002 DATA255,255,255,255,255,255,255,255,145,4,41,130,88,3,168,94
10003 DATA0,16,50,58,127,127,99,165,170,85,170,85,170,85,170,85
```

Catalogue

D J Sharpe,
Hull.

DRAGON

A VERY USEFUL facility found on the BBC machines is the ability to catalogue a cassette tape to screen. This program enables program cassettes produced for the Dragon 32 to be catalogued to the VDU screen in much the same way as for the BBC Micro. In addition, the number of blocks and parity errors are also displayed alongside the file name.

The program consists of a machine-code routine which reads a block of data from the cassette and stores it from a base location of 7100 hex. The Basic part of the program checks the block type and prints the appropriate data to screen.

During initialisation of the program, the machine-code routine is read from the Data statement and Poked to locations starting at 7000 hex. Locations 7080 and 7081 hex hold the number of parity errors and the number of blocks — 256 bytes per block — for a given file.

The machine-code routine makes use of the subroutines in the Basic ROM which start the cassette and move into bit sync, and read a block from cassette. These routines are accessed using the indirect jump-to-subroutine addresses A004 and A006 hex. The machine-code mnemonics and op-codes are given in the second listing.

Those with printers should find it relatively easy to convert the program to print the data to the printer instead of to the screen. Alternatively a string array could be used to store the data which could be read out after the tape has been completely read.

```
5 REM FOR "£" READ HASH CHARACTER
10 CLS:CLEAR 200,&H6FFF
20 PRINT @261,"CATALOGUE PROG"
30 FOR I=1 TO 2000:NEXT
40 REM LOAD MACHINE CODE PART
50 FOR I=&H7000 TO &H7033
60 READ A:POKE I,A:NEXT
70 CLS:PRINT @130,"PRESS ANY KEY WHEN":PRINT @162,"CASSETTE IS LOADED"
80 T$=INKEY$:IF T$=""THEN80
90 CLS
100 PRINT "filename    blks    errs"
110 DEF USR0=&H7000
120 X=USR0(0)
130 P$=""
140 IF PEEK(&H007C)=0 THEN 150 ELSE PRINT USING "£££££££";PEEK(&H7081),PEEK(&H70
80):GOTO 120
150 FOR I=7 TO 0 STEP -1
160 P$=CHR$(PEEK(&H7100+I))+P$:NEXT
170 PRINT P$;
180 GOTO 120
190 DATA 134,0,183,112,128,183,112,129,142,113,0,191,0,126,173,255,160,4,173,255
,160,6,38,17,182,0,124,39,22,43,20,182,112,129,76,183,112,129,126,112,18,182,112
,128,76,183,112,128,126,112,18,57
```

Swap

Peter Havlykke,
Bagsvaerd,
Denmark.

ZX-81

YOU HAVE probably seen machine-code programs before which store a Basic program, or just part of one, in a safe place above RAMtop, thus making room for another program in the Basic area. The stored program can then be taken back later for further use, thereby erasing the other program.

The programs I have seen so far, suffer from certain shortcomings. They can either be used only in Fast mode, or they always return the stored program in Slow mode. But worst of all you cannot exchange the programs. The one in the lower part of the memory is always erased when the stored program is taken back down. My machine-code program overcomes these failings. It even allows you to let the two programs swap each other, and they always return in the mode in which they were stored.

The machine-code is entered like this. First divide the 16K memory into two by the direct command:

```
POKE 16389,95
NEW
```

(continued on next page)

(continued from previous page)

Now make the well-known line 1 Rem statement with room for at least 53 characters. Use any hex loader to perform the hex dump. When this has been done, keep the Rem statement and delete the hex loader, and add:

```
2 SAVE "SWAP"
3 RAND USR 16514
```

save the program on tape. Whenever you Load it later, remember to Poke down RAMtop or the program will crash. Run the program. You should see a slight flicker and nothing else. then enter directly:

```
RAND USR 32525
```

You have now got a copy of the program above RAMtop. Press New and wipe out your Basic program. Try to list — it has all disappeared. Now if you type the following:

```
RAND USR 32530
```

List again and the Basic program is back. Let's try to swap. Load any program from tape, not bigger than 8K as the memory is divided in two. Then:

```
RAND USR 32539
```

and the programs will be exchanged. When put in a program line, this Rand Usr command will swap the programs, and when swapped back again, the Basic program will continue from where it left off when stored.

```
16514   11 00 7F 01 00 01 21 8E
16522   40 ED B0 C9 CD ED 02 11
16530   00 60 21 00 40 01 00 19
16538   C9 CD 00 7F 18 04 CD 00
16546   7F EB ED B0 C3 07 02 CD
16554   00 7F 1A ED A0 2B 77 23
16562   E2 07 02 18 F5
```

Defining characters

Neil Morrison,
Aylesbury,
Buckinghamshire.

SPECTRUM

THIS PROGRAM allows you to redefine everything but the user-defined graphics, ZX-81 graphics and the key-words — that is the whole character set, from space to the copyright symbol. When a character is redefined it will also appear among the keywords.

After saving the characters, to load them independently to the generator, type

```
CLEAR 31744
LOAD "" CODE
POKE 23607,123
```

The program then copies the Sinclair characters into locations 31744 upwards, and Pokes 23607 to make it point to them. Those with a 48K Spectrum can move RAMtop further up the memory and change the Clear and Poke statements accordingly.

```
  1 CLEAR 31743: PRINT AT 11,11
; FLASH 1; INK 1;"PLEASE■■■■■■ F
OR a=15616 TO 16383: POKE a+16512
8,PEEK a: NEXT a: POKE 23607,123
  2 BORDER 1: CLS : LET j=0: LE
T a$="N.H. PROGS 1983©": LET b$=
"GRAPHICS GENERATOR"
  3 LET i=0: FOR f=1 TO 16: PAU
SE 5: PRINT AT 10,f+5; INK i;CHR
$ (CODE a$(f TO )): IF i=5 THEN
LET i=0
  4 LET i=i+1: NEXT f: PAUSE 20
  5 LET i=0: FOR f=1 TO 16: PAU
SE 5: PRINT AT 15,f+4; INK i;CHR
$ (CODE b$(f TO )): IF i=5 THEN
LET i=0
  7 LET a$="PRESS ANY KEY TO BE
GIN"
  8 LET i=0: FOR f=1 TO 22: PRI
NT AT 21,f+2; INK i;CHR$ (CODE a
$(f TO )): PAUSE 5: IF i=5 THEN
LET i=0
  9 LET i=i+1: NEXT f: PAUSE 10
000
  10 CLS : INK 2: LET a=9: PLOT
79,39: DRAW 65,0: DRAW 0,65: DRA
W -65,0: DRAW 0,-65: INK 0: PRIN
T AT 19,0;: POKE 23607,123: FOR
n=32 TO 127: PRINT CHR$ n;: NEXT
n: POKE 23607,60
  11 PRINT AT 0,0;"1)To Recall O
ne"'"2)To Form One Using Numbers
"'"3)Save One On Tape"'"4)Load O
ne In"'"5)Form One Using Cursors
"'"6)Edit One"'"7)To Stop": PRIN
T #0;"Choice(1-7) "
  12 LET m$=INKEY$: IF m$<"1" OR
m$>"7" THEN GO TO 12
  14 IF m$="7" THEN PRINT AT 6,0
; FLASH 1;"7": FOR y=1 TO 200: N
EXT y: STOP
  15 IF m$="6" THEN PRINT AT 5,0
; FLASH 1;"6": PAUSE 500: GO TO
3000
  16 IF m$="1" THEN PRINT AT 0,0
; FLASH 1;"1": GO TO 210
  17 IF m$="3" THEN PRINT AT 2,0
; FLASH 1;"3": GO TO 1000
  18 IF m$="4" THEN PRINT AT 3,0
; FLASH 1;"4": GO TO 1050
  19 IF m$="5" THEN PRINT AT 4,0
; FLASH 1;"5": PAUSE 500: GO TO
1980
  20 PRINT AT 1,0; FLASH 1;2; IN
PUT "what letter? "; LINE a$: IF
 a$<" " OR a$>"©" THEN GO TO 20
  30 FOR f=0 TO 7
  40 INPUT "number? ";c
  50 POKE ((31744+(CODE a$-32)*8
)+f),c
  55 PRINT AT a,8; INK 2; BRIGHT
 1;f;AT a,19; BRIGHT 1;c: POKE 2
3607,123: PRINT AT 18,13; FLASH
1;CHR$ (CODE a$): POKE 23607,60
  60 IF c>127 THEN PRINT AT a,10
;"■": LET c=c-128
  70 IF c>63 THEN PRINT AT a,11;
"■": LET c=c-64
  80 IF c>31 THEN PRINT AT a,12;
"■": LET c=c-32
  90 IF c>15 THEN PRINT AT a,13;
"■": LET c=c-16
  100 IF c>7 THEN PRINT AT a,14;"
■": LET c=c-8
  110 IF c>3 THEN PRINT AT a,15;"
■": LET c=c-4
  120 IF c>1 THEN PRINT AT a,16;"
■": LET c=c-2
  130 IF c=1 THEN PRINT AT a,17;"
■": LET c=c-1
  140 LET a=a+1
  150 NEXT f
  160 PAUSE 30
  180 POKE 23607,123: CLS : FOR n
=32 TO 127: PRINT CHR$ n;" ";: N
EXT n
  190 PAUSE 1000
  200 GO TO 10
  210 INPUT "Which Character "; L
INE a$: IF a$<" " OR a$>"©" THEN
 GO TO 210
  220 LET a=9: FOR f=0 TO 7: LET
c=PEEK ((31744+(CODE a$-32)*8)+f
): PRINT AT a,19; BRIGHT 1;c;AT
a,8;f
  230 IF c>127 THEN PRINT AT a,10
;"■": LET c=c-128
  240 IF c>63 THEN PRINT AT a,11;
"■": LET c=c-64
  250 IF c>31 THEN PRINT AT a,12;
"■": LET c=c-32
  260 IF c>15 THEN PRINT AT a,13;
"■": LET c=c-16
  270 IF c>7 THEN PRINT AT a,14;"
■": LET c=c-8
  280 IF c>3 THEN PRINT AT a,15;"
■": LET c=c-4
  290 IF c>1 THEN PRINT AT a,16;"
■": LET c=c-2
  300 IF c=1 THEN PRINT AT a,17;"
■": LET c=c-1
  310 LET a=a+1
  320 NEXT f
  330 PAUSE 0: GO TO 10
1000 INPUT "Filename>"; LINE f$
1020 SAVE f$CODE 31744,768
1030 GO TO 10
1050 INPUT "Filename>"; LINE f$
1060 CLS : PRINT "Insert Cassett
2"
1070 LOAD f$CODE 31744,768
1080 GO TO 10
1980 INPUT "Which Character "; L
INE a$: IF a$<" " OR a$>"©" THEN
 GO TO 1980
1981 DIM c(8): CLS
1990 INK 2: PLOT 79,39: DRAW 65,
0: DRAW 0,65: DRAW -65,0: DRAW 0
,-65: INK 0: FOR x=9 TO 16: PRIN
T AT x,8; BRIGHT 1;x-8: NEXT x:
PRINT AT 7,10; BRIGHT 1;"1234567
8": PRINT AT 0,0;"Commands:-"'"C
ursor Keys To Move"'"O To Remove
"'"P To Fill"'"S To Stop Generat
or": LET d=128: LET a=9: LET b=1
0
2010 LET b$=INKEY$
2020 IF b$="5" AND b>10 THEN LET
 b=b-1: LET d=d*2
2030 IF b$="8" AND b<17 THEN LET
 b=b+1: LET d=d/2
2040 IF b$="6" AND a<16 THEN LET
 a=a+1
2050 IF b$="7" AND a>9 THEN LET
a=a-1
2060 IF b$="p" AND ATTR (a,b)=56
 THEN PRINT AT a,b; INK 2;"■": L
ET c(a-8)=c(a-8)+d
2070 IF b$="o" AND ATTR (a,b)=56
 THEN PRINT AT a,b;" ": LET c(a-
8)=c(a-8)-d
2075 POKE ((31744+(CODE a$-32)*8
)+(a-9)),c(a-8): POKE 23607,123:
 PRINT AT 18,15;CHR$ (CODE a$):
POKE 23607,60
2080 PRINT AT a,b; OVER 1; INK 8
;"+"
2090 PAUSE 5
2100 PRINT AT a,b; OVER 1; INK 8
;"+"
2110 IF b$="s" THEN PAUSE 0: CLS
: GO TO 180
2120 GO TO 2010
3000 INPUT "Which Do You Want To
 Edit ": LINE a$: IF a$<" " OR a
$>"©" THEN GO TO 3000
3001 INPUT "Which Character Into
": LINE f$: IF f$<" " OR f$>"©"
 THEN GO TO 3001
3002 DIM c(8): FOR q=1 TO 8: LET
 c(q)=PEEK ((31744+(CODE a$-32)*
8)+(q-1)): POKE USR f$+(q-1),c(q
): NEXT q
3005 CLS : INK 2: PLOT 79,39: DR
AW 65,0: DRAW 0,65: DRAW -65,0:
DRAW 0,-65: INK 0: PRINT AT 0,0;
"Commands:-"'"Cursors To Move"'"
O To Erase"'"P To Fill In"'"S TO
 Stop Edit"
3010 LET a=9: LET b=10: FOR f=0
TO 7: LET c=PEEK ((31744+(CODE a
$-32)*8)+f): PRINT AT f+9,8; BRI
GHT 1;f: FOR x=10 TO 17: PRINT A
T 7,x; BRIGHT 1;x-9: NEXT x
3015 INK 2
3020 IF c>127 THEN PRINT AT f+9,
10;"■": LET c=c-128
3030 IF c>63 THEN PRINT AT f+9,1
1;"■": LET c=c-64
3040 IF c>31 THEN PRINT AT f+9,1
2;"■": LET c=c-32
3050 IF c>15 THEN PRINT AT f+9,1
3;"■": LET c=c-16
3060 IF c>7 THEN PRINT AT f+9,14
;"■": LET c=c-8
3070 IF c>3 THEN PRINT AT f+9,15
;"■": LET c=c-4
3080 IF c>1 THEN PRINT AT f+9,16
;"■": LET c=c-2
3090 IF c=1 THEN PRINT AT f+9,17
;"■": LET c=c-1
3100 INK 0
3110 NEXT f
3120 LET d=128
3130 LET b$=INKEY$
3140 IF b$="5" AND b>10 THEN LET
 b=b-1: LET d=d*2
3150 IF b$="8" AND b<17 THEN LET
 b=b+1: LET d=d/2
3160 IF b$="6" AND a<16 THEN LET
 a=a+1
3170 IF b$="7" AND a>9 THEN LET
a=a-1
3180 IF b$="o" AND ATTR (a,b)=56
 THEN PRINT AT a,b;" ": LET c(a-
8)=c(a-8)-d
3190 IF b$="p" AND ATTR (a,b)=56
 THEN PRINT AT a,b; INK 2;"■": L
ET c(a-8)=c(a-8)+d
3200 PRINT AT a,b; INK 8; OVER 1
;"+": PAUSE 5: PRINT AT a,b; INK
 8; OVER 1;"+"
3210 POKE ((31744+(CODE f$-32)*8
)+(a-9)),c(a-8)
3220 POKE 23607,123: PRINT AT 20
,15;CHR$ (CODE f$): POKE 23607,6
0
3230 IF b$="s" THEN PAUSE 0: GO
TO 180
3240 GO TO 3125
```

Acorn Kong

Martin Exall,
Drayton,
Norwich.

ATOM

THIS GAME for the Acorn Atom is based on the arcade game Crazy Kong. The object of the game is to climb a layout of ladders and girders while avoiding the barrels which are constantly rolling along the girders. As you try to reach the top you can gain points by collecting the parasols which are positioned at various locations on the screen and are worth 100 points each.

The barrels must always be avoided. To do this you can either jump over them if there is enough headroom, or you can climb on to a ladder. When the barrel hits the edge of the screen on a level below you it will reappear on the level above you.

Your man can be moved using the following keys:

(continued on page 167)

P A S E S O F T

BBC 32K
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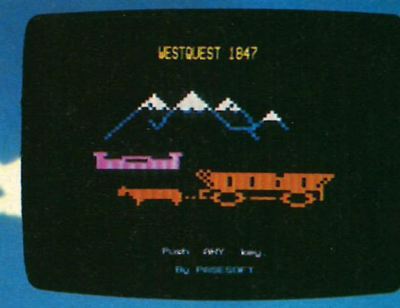

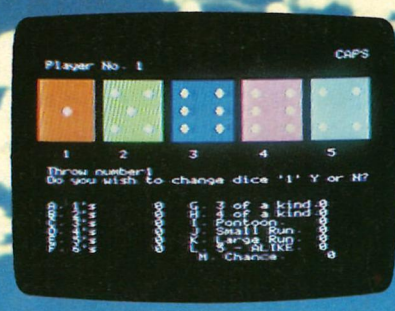

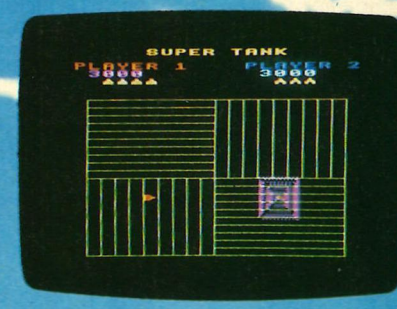

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CLUB EXPANDS TO INCLUDE COMMODORE 64 AND ORIC USERS

Two excellent new machines have just been added to our coverage – the Commodore 64 and the Oric. Software for these machines will be in our next Newsletter. Remember, membership is completely free of charge and you are under no obligation to buy anything from the Club unless you really want to. If you use a ZX81 (16k), Spectrum (16k or 48k), BBC (A or B), Dragon 32, Vic (expanded or unexpanded), Commodore 64 or Oric, you should join THE CLUB.

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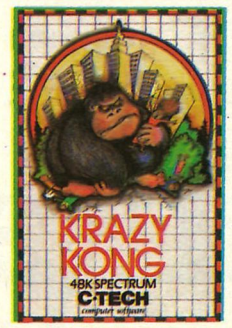
Super Centipede is a full colour machine code arcade game where the object is to defend yourself with your laser against a fast moving centipede which weaves in and out of the mushroom patch. Beware of the man eating spider!

Painter-You must diffuse the time bombs in numerical order whilst leaving a trial but you must not cross your path.

For 16K/48K Spectrum £5.50



FROGGER
and SPECMAN

Specman-has great machine code graphics with 3 to 5 ghosts, power pills and a real munchie man who munches in all directions.

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& CITY BOMBER

This is an ingenious program for the Dragon 32. It begins with a briefing session giving details of the several attack waves and shows you pictures of the aircraft including Messerschmidt and Junkers. You have to get the aeroplanes within your sights and shoot them down. There is a parachuting sequence. It makes full use of Hi-Res graphics, colour and sound. **All this for £5.50**

KRAZY KONG

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YC0683 — Your Computer — July 1983

(continued from page 162)

Z — left
C — right
S — up
X — down

If Shift is pressed with one of the keys, this will make your man jump in the appropriate direction — for example, shift C jumps you to the right. Jumps are used to avoid barrels and to cross gaps in girders. Beware of the X key because it moves you down whether or not there is a ladder beneath you.

If your man falls from too great a height he will be killed. Press R for another game. The game has four stages, and you receive a large bonus when progressing to each new stage. To finish each stage just climb to the highest point on the screen and jump off. The first three levels can always be scaled, but the fourth with no ladders is sometimes impossible. You may have to go out of your way to pick up a parasol, but this must be done before a barrel rolls over it.

This program uses high-resolution graphics and user-defined characters which are stored in the floating-point variables space. The program uses all the available lower text space memory so it should be typed in exactly as in the listing.

```
100 GOS.w
110 GOS.x
120 S=0;L=0;Z=0
130 CLEAR4
140 GOS.a;GOS.s
150 O=6;GOS.c;GOS.d
160 GOS.2120
170 M=#9600;N=0;O=22
175 X=N;Y=O;?#82=0;GOS.z
180 GOS.b;IF Z=1;G.v
190 GOS.e;IF Z=1;G.v
195 IF Z=2;Z=0;G.130
200 GOS.f
205 F.J=0TO5;WAIT;N.
210 G.180
999 E.
1170aIF L=1 OR L=2 G.1370
1180 F.J=1 TO 140 S.32-16*(L>2)
1190 MOVE 0,J
1200 F.K=0 TO 31
1210 PLOT 1,4,0;PLOT 1,0,4;PLOT 1,4,0;PLOT 1,0,-4
1220 N.K
1230 PLOT 1,0,6
1240 PLOT 1,-256,0
1250 N.J
1260 F.J=7 TO 21 S.4-2*(L>2)
1270 Y=J+1;X=A.R.%29+1;?#82=#10;GOS.y
1280 T=A.R.%28+1;U=A.R.%28+1
1290 Y=J;X=U;?#82=#20;GOS.y
1300 IF L>2 G.1340
1310 F.K=0 TO 3
1320 Y=J+K;X=T;?#82=#18;GOS.y
1330 N.K
1340 N.J
1350 MOVE 200,143;PLOT 1,7,0
1360 MOVE 216,159;PLOT 1,7,0
1370 IF L<>1 G.1560
1380 X=18;Y=17;U=06;GOS.u
1390 X=28;Y=14;U=02;GOS.u
1400 X=25;Y=16;U=04;GOS.u
1410 X=00;Y=00;U=32;GOS.u
1420 X=00;Y=16;U=18;GOS.u
1430 X=16;Y=02;U=03;GOS.u
1440 X=02;Y=08;U=05;GOS.u
1450 X=20;Y=04;U=12;GOS.u
1460 X=00;Y=04;U=11;GOS.u
1470 X=11;Y=06;U=09;GOS.u
1480 X=21;Y=08;U=03;GOS.u
1490 X=24;Y=12;U=07;GOS.u
1500 X=00;Y=12;U=21;GOS.u
1510 X=13;T=12;GOS.t
1520 X=00;T=10;GOS.t
1530 X=00;T=14;GOS.t
1540 X=24;T=11;GOS.t
1550 X=05;T=02;GOS.t
1560 IF L<>2 G.1750
1570 X=00;Y=16;U=20;GOS.u
1580 X=21;Y=16;U=10;GOS.u
1590 X=00;Y=12;U=20;GOS.u
1600 X=21;Y=12;U=02;GOS.u
1610 X=22;Y=10;U=02;GOS.u
1620 X=12;Y=18;U=07;GOS.u
1630 X=27;Y=02;U=04;GOS.u
1650 X=29;Y=00;U=00;GOS.u
1660 X=02;Y=08;U=03;GOS.u
1670 X=00;Y=00;U=32;GOS.u
1680 X=02;Y=04;U=26;GOS.u
1690 X=18;Y=08;U=14;GOS.u
1700 X=25;T=07;GOS.t
1710 X=00;T=11;GOS.t
1720 X=00;T=15;GOS.t
1730 X=05;T=02;GOS.t
1740 X=25;T=11;GOS.t
1750 IF L<>1 AND L<>2 G.1790
1760 X=1;Y=8;?#82=#10;GOS.y
1770 X=3;Y=14;?#82=#10;GOS.y
1780 X=30;Y=20;?#82=#10;GOS.y
1790 IF L<>2 G.1830
1800 F.J=0 TO 5
1810 Y=4;X=13+J;?#82=8;GOS.y
1820 N.J
1830 R.
1900uMOVE (X*8),(Y*8+6)
1905 F.J=1 TO U-1
1910 PLOT 1,4,-2;PLOT 1,4,2
1920 N.
1930 PLOT 1,4,-2;PLOT 1,3,3
1940 PLOT 1,-%(8*(U-.1)),0
1950 R.
1960tF.U=0 TO 3
1970 Y=T+U;?#82=#18;GOS.y
1980 N.
1990 R.
2000bX=C;Y=D;?#82=8;GOS.z
2010 X=G;Y=H;?#82=8;GOS.z
2020 B=B+E;C=C+E
2030 IF C<1 OR C>30 E=-E;IF D>0 GOS.c
2050 IF ?(B+256)=0 B=B+512;D=D+2
2060 IF ?B=8;Z=1;R.
2065 IF ?B=#8E;X=C;Y=D;?#82=#20;GOS.y
2070 F=F+I;G=G+I
2080 IF G<1 OR G>30 I=-I;IF H>0 GOS.d
2100 IF ?(F+256)=0 F=F+512;H=H+2
2110 IF ?F=8;Z=1;R.
2115 IF ?F=#8E;X=G;Y=H;?#82=#20;GOS.y
2120 X=C;Y=D;?#82=8;GOS.z
2130 X=G;Y=H;?#82=8;GOS.z
2140 R.
2150cE=1;C=1;D=2*%(O/3);B=#8000+256*D+C;R.
2160dI=-1;G=30;H=2*%(O/3);F=#8000+256*H+G;R.
3000eLINK LL4;Q=?#80
3010 IF Q=255 R.
3020 R=0;V=0;W=0
3030 IF Q=58 AND N>0 R=-1;V=-1
3040 IF Q=35 AND N<31 R=1;V=1
3050 IF Q=56 AND O<22 R=256;W=1
3060 IF Q=51 R=-256;W=-1
3070 IF R=0 R.
3080 IF ?#B001>127 OR Q=56;G.3300
3085 IF O<4;S=S*2+100;L=L+1;Z=2;R.
3090 IF V=-1 AND N<2 R.
3100 IF V=1 AND N>29 R.
3110 IF ?(M-256)=#FF OR ?(M-512)=#FF;Z=1;R.
3120 X=N;Y=O;?#82=0;GOS.z
3130 M=M-512+V+V;N=N+V+V;O=O-2
3140 IF ?M<>#8E G.3170
3150 X=N;Y=O;?#82=#20;GOS.y
3160 S=S+100;GOS.s
3170 X=N;Y=O;?#82=0;GOS.z
3180 GOS.b;IF Z=1;R.
3190 U=0
3200 X=N;Y=O;?#82=0;GOS.z
3210 IF ?(M+256)=#FF OR ?(M+256)=#44;IF U<3;G.3280
3220 IF ?(M+256)=#FF OR ?(M+256)=#44;IF U>2;Z=1;R.
3230 IF ?(M+256)=#18;G.v
3240 M=M+256;O=O+1
3245 U=U+1
3250 X=N;Y=O;?#82=0;GOS.z
3270 G.3200
3280 X=N;Y=O;?#82=0;GOS.z
3290 R.
3300 IF ?(M+V)<>#8E G.3360
3310 X=N;Y=O;?#82=0;GOS.z
3320 M=M+R;N=N+V;O=O+W
3330 X=N;Y=O;?#82=0;GOS.y
3340 S=S+100;GOS.s
3350 R.
3360 X=N;Y=O;?#82=0;GOS.z
3370 IF W<>-1;G.3410
3380 IF ?(M-256)>0 G.3410
3390 IF ?(M+256)=#44;G.3410
3400 X=N;Y=O;?#82=0;GOS.z;R.
3410 IF ?(M+R)=#18;Z=1;R.
3430 M=M+R;N=N+V;O=O+W
3440 X=N;Y=O;?#82=0;GOS.z
3450 R.
4000fIF ?(M+256)<>0 R.
4010 G.3190
5000vN=N-2
5010 X=N;Y=O;?#82=#28;GOS.y
5020 X=N+1;Y=O;?#82=#30;GOS.y
5030 X=N+2;Y=O;?#82=#38;GOS.y
5040 X=N+3;Y=O;?#82=#40;GOS.y
5050 X=N+4;Y=O;?#82=#48;GOS.y
5060 F.J=0TO50;?#B003=4;?#B003=5;N.
5070 DO;WAIT;LINK LL4;U.?#80=50
5080 RUN
6000sSTR S,540
6010 J=0;U=540
6020 DO;K=U?J
6030 K=K-48;K=K*8
6040 ?#82=(#50+K);Y=3;X=(14+J)
6050 GOS.y
6060 J=J+1
6070 U.U?J=46
6080 R.
9000wP=#28A0
9010 DIM LL4
9020 P.$12$21
9030[
9040:LL0 LDX @0;LDY @0
9050:LL1 LDA (#82),Y;STA (#80,X)
9060 INY
9070 LDA #80;CLC;ADC@#20;STA #80
9080 LDA #81;ADC@0;STA #81
9090 CPY @8;BNE LL1
9100 RTS
9110:LL2 LDX @0;LDY @0
9120:LL3 LDA (#82),Y;EOR (#80,X);STA (#80,X)
9130 INY
9140 LDA #80;CLC;ADC@#20;STA #80
9150 LDA #81;ADC@0;STA #81
9160 CPY @8;BNE LL3
9170 RTS
9180:LL4 JSR #FE71;STY#80;RTS
9190]
9200 P.$6
9210 R.
9500xU=#2800
9510 !U=#3C987E08;U!4=#36242424
9520 U!8=#FF7E7E18;U!12=#187E7EFF
9530 U!16=#5060718E;U!20=#84828488
9540 U!24=#7C444444;U!28=#44444444
9550 U!32=0;U!36=0
9551 U!40=#1C20221C;U!44=#1C2202
9552 U!48=#3C22223C;U!52=#202020
9553 U!56=#20202020;U!60=#3E2020
9554 U!64=#22221408;U!68=#22223E
9555 U!72=#0808083E;U!76=#080808
9556 U!80=#2A26221C;U!84=#1C2232
9557 U!88=#08081808;U!92=#1C0808
9558 U!96=#1C02221C;U!100=#3E2020
9559 U!104=#0C02221C;U!108=#1C2202
9560 U!112=#3E140C04;U!116=#040404
9561 U!120=#023C203E;U!124=#1C2202
9562 U!128=#3C20201C;U!132=#1C2222
9563 U!136=#0804023E;U!140=#202010
9564 U!144=#1C22221C;U!148=#1C2222
9565 U!152=#1E22221C;U!156=#1C0202
9600y?#81=(#80+Y)
9610 ?#80=X
9620 ?#83=#28
9630 LINK LL0
9640 R.
9700z?#81=(#80+Y)
9710 ?#80=X
9720 ?#83=#28
9730 LINK LL2
9740 R.
```

Scroll roles

Alan Wagstaff,
Scotton,
North Yorkshire.

BBC

THIS ASSEMBLY-language program enables interesting effects to be obtained in Mode 7. Any section of the screen display can be scrolled left or right, disappearing and reappearing on the other side. Any number of such sections or windows can be effective simultaneously. Each window is defined in terms of normal printing co-ordinates.

After keying in the listing, save it on tape and then run it. The machine code will be assembled, starting at address C00 hex. This can be changed if desired — see line 30. New should then be entered, followed by the Basic program which is to make use of the machine code.

Alternatively, the Basic program and the assembly listing could be merged into one single program. The assembly language uses integer variables R%, Q%, L%, W%. The Basic program should not alter these.

The machine code is accessed from Basic by using the Call command.

CALL R% will rotate a window to the right
CALL L% rotates to the left
CALL Q% causes the window to disappear to the right.
CALL W% disappears to the left.

Each Call command must pass four parameters, all integer variables, which have previously had values allocated to them. For example,

CALL R%, X1%, X2%, Y1%, Y2%

will rotate to the right a section of screen display between X1% and X2%, left to right,

(continued on page 171)

SOFTEK

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PCW June '83

June/July 1983.
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"*Super C* comes well-packaged in a large box that opens like a book to reveal the cassette nestling inside along with a 22-page instruction manual."

"The most impressive demonstration is the third, a very simple *Invaders* program. In Basic it is very slow, and you wouldn't want to play it for more than a few seconds. When compiled, the program becomes very much faster, and the game is at least bearable for a couple of minutes!"

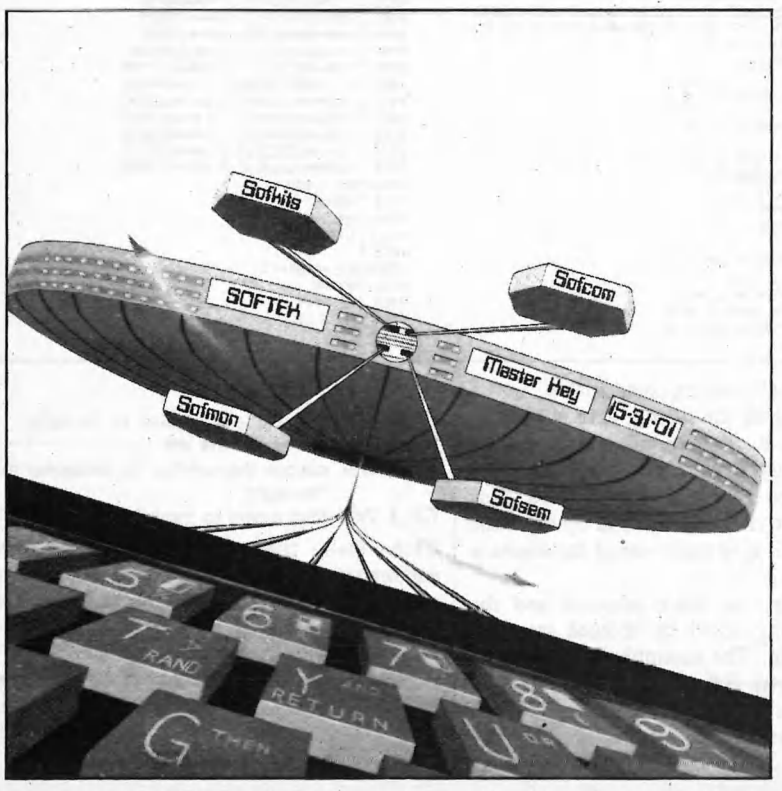
"The total *Sofsys* package can be recommended, and the Compiler, in particular, though expensive at £15, is worth every penny."

POPULAR COMPUTING WEEKLY

26 MAY-1 JUNE 1983

Silversoft program *Slippery Sid* which was written using the *Super C* Spectrum compiler from Softek.

"SOFCOM/*Super C* is sold subject to the condition that it is not used to write commercial programs without permission."



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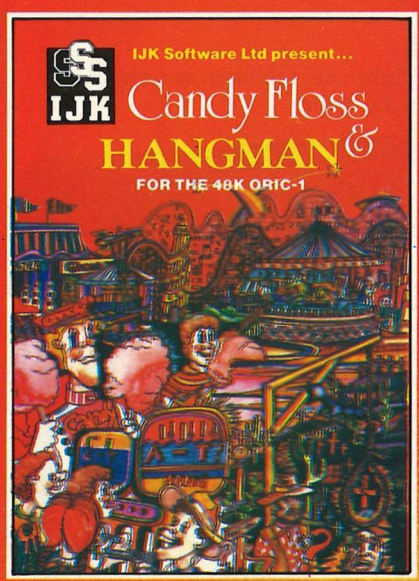

As Fleet Commander in the Xenon Space Academy, you must protect your home planet RADON from the AARDS, PARATRONS, and the ZORGON Battle Star! If you want a 100% machine code multi stage arcade game with the smoothest, meanest action around, this is the one for you – you will not buy a better arcade style game.
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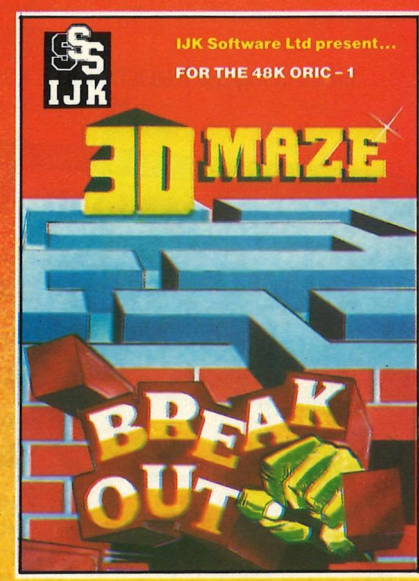

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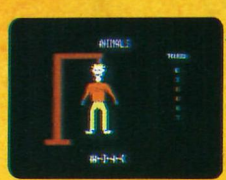

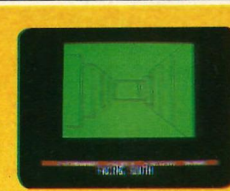

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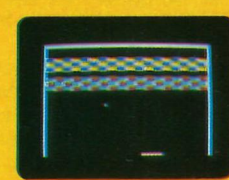

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Trade in your ZX81 by post or over the counter at our premises. (Phone first to check current delivery). Trade-in ZX81s must be clean and in working order. Send and receive the computer only, without manuals, power supplies etc.

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Plug the chip-set (Issue 2) or circuit board (Issue 1 £35) into the sockets provided by Sinclair and you have a standard 48k Spectrum, fully compatible with all Sinclair add-ons and very low in power consumption. No soldering is required. Fitting and removal are easy. The SP48 carries our full warranty and is upgradable on a part-exchange basis to the SP80.

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Fitting, power consumption and add-on compatibility are identical to the SP48 (Issue 1 version £50). It can be used as a standard 48k, but software instructions can switch to a second page of 32k. Although not recommended for the complete beginner, the SP80 is of tremendous benefit to the serious user.

Fit and Test Service: At our premises £3
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ZX SLOWLOADER £10

Loads ZX81 tapes into your Spectrum. A recent letter describes it best.
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I bought it because I was nearing the completion of a project which uses practically everything in 16k RAM including a string array (DIM 629,7) which took 4 hours hard graft to bash in. I really did not fancy doing it all again.
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(continued from page 167)

and between Y1% and Y2%, top to bottom. The assembly language listing consists of four routines, Q%, lines 50 to 240, R%, lines 250 to 460, W%, lines 480 to 670, and L%, lines 680 to 890. Lines pertaining to any unwanted routine need not be entered.

Line 470 and lines 900 onward must be retained. Line 470 is the exit back to the Basic program and lines 900 onwards contain two subroutines, Paras and Add.

The subroutine Paras obtains the four parameters from a block starting at 600 hex — see page 214 of the *User Guide* — and places them on zero page where the machine code can manipulate them.

The subroutine Add adds multiples of 40 to Himen to move to the correct line of the display. The short Basic program can be entered to demonstrate the capabilities of the machine code.

```
 10REM FOR £ READ
 15REM HASH CHARACTER
 20FORF%=0TO1
 30P%=&C00
 40[OPT F%*2
 50.Q% JSR paras
 60.f1 DEC&72
 70BEQ s1
 80JSR add
 90JMP f1
100.s1 LDY&71
110.m1 DEY
120LDA(&80),Y
130INY
140STA(&80),Y
150DEY
160CPY&70
170BEQ n1
180JMP m1
190.n1 LDA£32
200STA(&80),Y
210DEC&73
220BEQ fini
230JSR add
240JMP s1
250.R% JSR paras
260.f2 DEC&72
270BEQ s2
280JSR add
290JMP f2
300.s2 LDY&71
310LDA(&80),Y
320TAX
330.m2 DEY
340LDA(&80),Y
350INY
360STA(&80),Y
370DEY
380CPY&70
390BEQ n2
400JMP m2
410.n2 TXA
420STA(&80),Y
430DEC&73
440BEQ fini
450JSR add
460JMP s2
470.fini RTS
480.W% JSR paras
490.f3 DEC&72
500BEQ s3
510JSR add
520JMP f3
530.s3 LDY&70
540.m3 INY
550LDA(&80),Y
560DEY
570STA(&80),Y
580INY
590CPY&71
600BEQ n3
610JMP m3
620.n3 LDA£32
630STA(&80),Y
640DEC&73
650BEQ fini
660JSR add
670JMP s3
680.L% JSR paras
690.f4 DEC&72
700BEQ s4
710JSR add
720JMP f4
730.s4 LDY&70
740LDA(&80),Y
750TAX
760.m4 INY
770LDA(&80),Y
780DEY
790STA(&80),Y
800INY
810CPY&71
820BEQ n4
830JMP m4
840.n4 TXA
850STA(&80),Y
860DEC&73
870BEQ fini
880JSR add
890JMP s4
900.paras LDA&601
910STA&80
920LDA&602
930STA&81
940LDX£0
950LDA(&80,X)
960STA&70
970LDA&604
980STA&80
990LDA&605
1000STA&81
1010LDA(&80,X)
1020STA&71
1030LDA&607
1040STA&80
1050LDA&608
1060STA&81
1070LDA(&80,X)
1080STA&72
1090LDA&60A
1100STA&80
1110LDA&60B
1120STA&81
1130LDA(&80,X)
1140SEC
1150SBC&72
1160STA&73
1170LDA6
1180STA&80
1190LDA7
1200STA&81
1210INC&72
1220INC&73
1230RTS
1240.add CLC
1250LDA£40
1260ADC&80
1270STA&80
1280LDA£0
1290ADC&81
1300STA&81
1310RTS:]
1320NEXT
1330REM A. WAGSTAFF
1340REM 1983
```

```
 10MODE7:VDU23;8202;0;0;0;
 20PRINTTAB(0,3)CHR$129;CHR$141;"DEMONSTRATION"
 30PRINTTAB(0,4)CHR$129;CHR$141;"DEMONSTRATION"
 40FORF%=6TO12:PRINTTAB(0,F%)STRING$(40,"*"):NEXT
 50PRINTTAB(0,15)CHR$130;CHR$141;"BBC MICROCOMPUTER"
 60PRINTTAB(0,16)CHR$130;CHR$141;"BBC MICROCOMPUTER"
 70PRINTTAB(0,18)CHR$134;"Press a key...":A%=GET
 80FORF%=1TO20
 85PROCSCROLL(Q%,0,9,7,11)
 90PROCSCROLL(W%,10,19,7,11)
100PROCSCROLL(Q%,20,29,7,11)
105PROCSCROLL(W%,30,39,7,11)
110NEXT
120PRINTTAB(0,18)CHR$132;"Press 'R' to reverse,"'CHR$132;
"       'F' to go fast
er,"'CHR$132;"       'S' to slower."
125D%=300
130REPEAT
135FORF%=1TOD%:NEXT
140PROCSCROLL(R%,2,37,3,4)
150PROCSCROLL(L%,2,37,15,16)
160IF INKEY(-52) C%=L%:L%=R%:R%=C%
162IF INKEY(-68) D%=D%-10
164IF INKEY(-82) D%=D%+10
170UNTIL FALSE
180DEFPROCSCROLL(s%,x1%,x2%,y1%,y2%)
190CALL s%,x1%,x2%,y1%,y2%
200ENDPROC
```

Doolhof

J A Verhave,
London.

DRAGON

YOU ARE a blue dot in the middle of a Doolhof, and your mission is to find five green treasures in the shortest possible time, without climbing the wall. You will start in the centre of the screen and move by pressing the cursor control keys. If you hit a wall, you will be warped at random and depending on your speed of reaction you can continue the hunt from there.

Pressing the @ key allows you to penetrate a wall. That is necessary because treasures may be hidden in a confined space — but not more than five times.

When the tune plays, the game and the timer start. Take your time to locate the treasures and to identify the shortest path and try to outwit your opponent both in time and the number of crashes into the wall. Once you start moving there is no going back. Your maximum time is set at five minutes, but can be increased.

If you have familiarised yourself with the game and if you wish to see the drawing of the Doolhof, add the following line;

105 PMODE 3,1:SCREEN 1,0

By the way, Doolhof is Dutch for maze.

```
10 REM DOOLHOF(C) J.A.VERHAVE APR.'83
20 PMODE1,1:SCREEN1,0
30 STIME=15000:LWALL=2000
40 CLS:PRINT"************DOOLHOF*************"
50 PRINT" YOU ARE A BLUE DOT IN THE       MIDDLE OF THE SCREEN AND YOUR   MISSIO
N IS TO FIND 5 TREASURES"
60 PRINT" YOU CAN MOVE BY PRESSING THE    CURSOR CONTROL KEYS."
70 PRINT:PRINT" BY PRESSING THE '@' KEY YOU CAN PENETRATE A WALL (MAX 5 TIMES)"
80 PRINT" HIT A WALL AND YOU WILL BE      WARPED AT RANDOM!!"
90 PRINT:PRINT" WHEN TUNE PLAYS GAME AND TIMER  STARTS."
100 REM*** DRAW SCREEN *********
110 PCLS2:COLOR4,2
120 FOR I=0 TO 20
130 LINE(I*13.5,0)-(I*13.5,191),PSET
140 LINE(0,I*10)-(255,I*10),PSET
150 NEXT I
160 REM*** MAKE RANDOM HOLES ***
170 FOR I=0 TO 18
180 FOR J=1 TO 18
190 R=RND(5):IF R=1 OR R=2 THEN GOTO 210
200 PRESET(J*13.5,I*10+4):PRESET(J*13.5,I*10+6)
210 R=RND(5):IF R=1 OR R=2 THEN GOTO 230
220 PRESET(I*13.5+4,J*10):PRESET(I*13.5+6,J*10)
230 NEXT J,I
240 REM***** PUT TRESSURES *****
250 FOR I=1 TO 5:X=RND(18):Y=RND(18):PSET(X*13.5+4,Y*10+4,1):NEXT I
260 PLAY"V21T255O4L8GAFADAP5O4GAFADAP4O3GAFADAP3O4GAFADAP2O5GAFADAP1OF£F£F£F
F£F£F£"
270 PMODE1,1:SCREEN1,0
280 TIMER=0
290 X=126:Y=96
300 REM***** MOVE LOOP *********
310 A$=INKEY$
320 IF A$=CHR$(8) THEN QQ=1
330 IF A$=CHR$(9) THEN QQ=2
340 IF A$=CHR$(10) THEN QQ=3
350 IF A$=CHR$(94) THEN QQ=4
360 IF QQ=1 THEN X=X-1
370 IF QQ=2 THEN X=X+1
380 IF QQ=3 THEN Y=Y+1
390 IF QQ=4 THEN Y=Y-1
400 IF X<0 OR X>255 OR Y<0 OR Y>191 THEN GOSUB 480
410 IF TIMER>15000 THEN GOTO 560
```

(continued on page 175)

dk'tronics

ZX KEYBOARD FOR USE WITH/81 SPECTRUM

Our new cased keyboard has 52 keys, 12 of these are used for the numeric pad. The numeric pad offers some useful features, you can cursor with one hand and it will be a boon for anyone who enters a lot of numeric data. The pad is a repeat of the 1-9 keys plus it has a full stop and a shift key. The numeric pad keys are coloured in red, the normal keyboard keys are grey, with the case being black which makes the whole thing very attractive. The case measures 15 × 9 × 2½. The computer (either 80/81 or spectrum) fits neatly inside. You will have to remove the computer from its original case, it is then screwed to the base of the case. The case had all the bosses already fitted and the screw holes are marked. Also fitted inside the case is a mother board (81 model only) which allows 16K, 32K and 64K to be fitted in the case. All the connections are at the rear of the case i.e. Power, Mic, Ear, T.V. and the expansion port. The case is large enough for other add ons also to be fitted inside. One of these could be the power supply, then you could very quickly fit a mains switch, or a switch on the 9V line. This means you have a very smart self-contained unit. This case does not stop you from using any other add-ons that you may have e.g. Printer etc. We are convinced that this is the best keyboard available at present. It offers more keys and features than any other keyboard in its price range.

£45

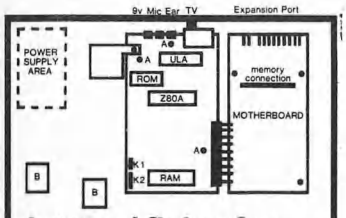
KEYBOARD (SPECTRUM/81)

NOTE

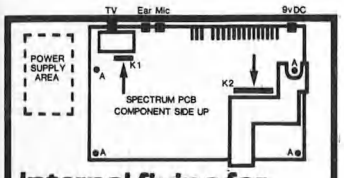
The case can be purchased separately with the keyboard aperture uncut, so if you have one of our early uncased keyboards, or in fact any other suppliers' keyboards, these could be fitted. The keyboard is connected to your computer by a ribbon cable and this has connectors fitted which simply push into the Sinclair connectors. It is a simple two minute job and requires no electronic skills. This keyboard does not need any soldering. Please specify on order whether you require the ZX 81 or Spectrum case.

SPECTRUM MODEL

This is supplied with spectrum legends, and a slightly different base for fitting the spectrum inside, again all the connectors are at the rear of the case and there is plenty of room for the power supply (and other add-ons). Should you want to change, we can supply both the Spectrum legends and details of updating your case which will enable modification from the ZX 81 to spectrum. PLEASE specify on your order whether you require the ZX 81 or spectrum case.



Internal fixing for ZX 81 keyboard case.



Internal fixing for spectrum keyboard case.

16K Memory Expansion £22.95
The 16K uses 4116 Dynamic Ram Chips. We use the dynamic as they are much denser than Static Ram and occupy less space. They are also much cheaper than the equivalent product using the Static Ram. The Ram is manufactured with high quality materials, and uses high speed low power Rams. It is supplied ready-built and only needs to be plugged into the rear of the computer. All the components are fitted into holders. This massive add-on memory which comes to you fully assembled and tested is the cheapest 16K memory available anywhere. Position in memory from 16384 to 32768. (Same as the Sinclair memory.)
16K (UNCASED) £19.95

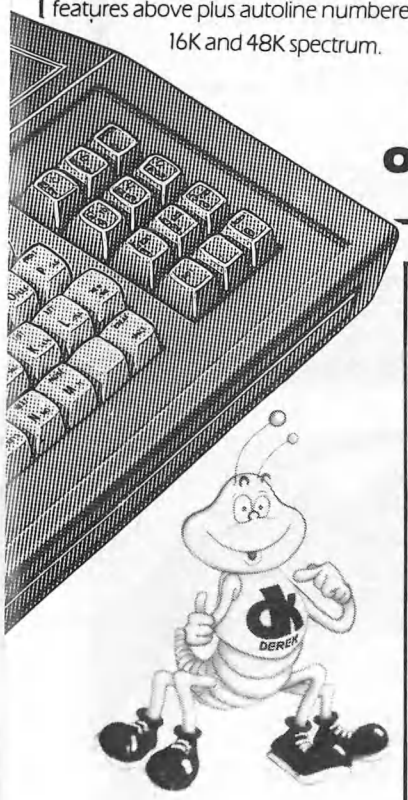
64K Memory Expansion £52.95
All the above information on the 16K also applies to the 64K Memory Expansion, but the advantage lies in the 64K giving nearly FOUR times the memory. This advanced model has 56K of usable memory. In addition, the block from 8K to 16K can be switched out to enable the use of other add-ons. The graphics ROM is to be used in this area. Position in Memory: 8192-65536. The Block From 8192-16384 is switchable. **64K (UNCASED) £49.95**

Spectrum Memory Expansion MK1 £35.00, MKII £30.00.
Upgrade your Spectrum to 48K of user Ram. The Spectrum memory expansion is simple to fit, it is simply slipped inside the case, and then only requires plugging in. Full fitting instructions are supplied, and the only tool you will need is a screwdriver and just two minutes of your time. The fitting requires no electronic skills. Position in memory from 32768 to 65536. (The same as Sinclair's upgrade to 48K).

ZX 80~81 Spectrum HARDWARE

SPECTRUM/81 TOOLKIT

This is the toolkit which won acclaim in the feature in the August 1982 issue (pages 29 and 30) of Sinclair User. "It is the most impressive program, fast in execution with clear and full instructions...it stands out from the rest of the field." The ZXED is a powerful editor for use on the expanded ZX81. It is intended for use by the serious BASIC programmer and offers several useful and time saving features most helpful during all stages of program development. The facilities provided are as follows: ALTER, BYTES, COPY, DELETE, FIND, HELP, INSERT, KEEP, MOVE, RENUMBER AND VERIFY. The Spectrum Toolkit contains most of the features above plus autoline numberer and append, and will run in the 16K and 48K spectrum.



Both at only £6.95

4K GRAPHICS ROM £24.95

The DK Graphic module is our latest ZX 81 accessory. This module unlike most other accessories fits neatly inside your computer under the keyboard. The module comes ready built, fully tested and complete with a 4K graphic ROM. This will give you an unbelievable 448 extra pre-programmed graphics, your normal graphic set contains only 64. This means that you now have 512 graphics and with their inverse 1024. This now turns the 81 into a very powerful computer with a graphic set rarely found on larger more expensive machines. In the ROM are lower case letters, bombs, bullets, rockets, tanks, a complete set of invaders graphics and that only accounts for about 50 of them, there are still about 400 left (that may give you an idea as to the scope of the new ROM). However, the module does not finish there, it also has a spare holder on the board which will accept a further 4K of ROM/RAM. This holder can be fitted with a 1K/2K/RAM and can be used for user definable graphics so you can create your own custom character sets.

WHY WAIT?
ORDER TODAY FOR FAST DELIVERY

FLEXIBLE RIBBON CONNECTOR

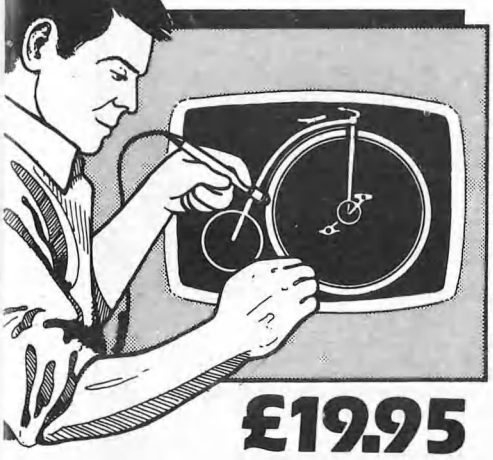
If you have ever had whiteouts or system crashes this could be the answer. It stops the movement between the computer and the RAM expansion, it is supplied with a ribbon, 6 inches long, with a male connector at one end and a female at the other, at only **£10**

16/64 MEMORY FOR ZX 81

16K Memory £22.95
16K (uncased) £19.95
64K Memory £52.95
64K (uncased) £49.95

The above illustration shows the casing for the 16K or massive 64K.

SPECTRUM LIGHT PEN



The pen enables you to produce high resolution drawings on your own television set, saving a vast amount of time over using basic programming statements, such as Plot, Draw etc. You can erase, modify and save drawings and it comes complete with software program. The superb light pen is available from D.K. tronics.

£19.95

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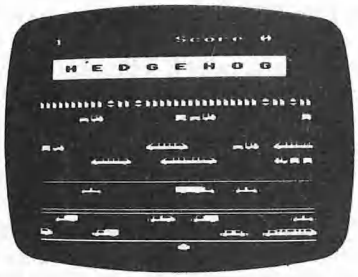

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March Issue: Program Features: Life (32K), Artillery Dual (16K/32K), Square Dance, Microsketch (16K) screen drawing program in only one line of code. 3D Rotation (will rotate any object). Printers for the BBC micro — Review of Epson, Seikosha, Tandy and Olivetti. What to do with the new Operating System Chip, Disc Formatter Program, and full Disc instruction set, Newcomers article on Text and Graphics Windows. **PLUS** How to get a new Operating System ROM and a special deal on Wordwise (members only).

April/ May Issue Special Anniversary Issue — Contains index to the whole of BEEBUG Volume 1. Music Composer — create complex 3 part harmonies with this synthesiser Program. **Colour bar chart generator** program. Beeb implementation of the **Connect-Four Game. Invasion** — a 16K. Plus **Review of Tape Recorders** for the Beeb; a Basic Program Editor, which lists variables and procedures, and executes find and Replace in a Basic Program; **Reviews of Acornsoft Games** and the **Torch Z80 Disc** Pack. Disc Menu Program. Newcomers introduction to Mode 7. How to save the unsaveable; and a routine to print Double Height characters in all modes.

June Issue: Program Features **'Return of the Diamond'** A 16K adventure game, **'hedgehog'** a well implemented 'Frogger' type game, and **Ellipto.** Create your own off the shelf sound effects with **Sound Wizard.** Plus articles on **using Files, Rotating and Expanding Characters, Using Printers,** and **How to multi-program the User Keys.** Reviews of **The Hobbit Floppy Tape System, Adventure Games,** and a **Comparative Review of Wordwise and View.** Plus **FX Call Update, Disc Program Auto-relocator, Wordwise Update,** and more **BBC Book Reviews.**

STOP PRESS
BEEBUG has negotiated a deal with ACORN over the new 1.2 OPERATING SYSTEM ROM. BEEBUG members are offered the ROM at around half-price. See BEEBUG Feb. Issue for details.

SOFTWAREE DETAILS

BEEBUGSOFT : BEEBUG SOFTWARE LIBRARY
offers members a growing range of software from £3.50 per cassette. 1. Starfire (32K). 2. Moonlander (16K). 3D Noughts and Crosses (32K). 3. Shape Match (18K). **Mindbinder** (16K). 4. Magic Eel (32K). 5. Cylon Attack (32K). 6.Astro-Tracker (32K). **Utilities:** 1. Dissembler (16K). Redefine (16K). Mini Text Ed (32K). **Applications:** 1. Superplot (32K). 2. Masterfile (32K).

Magazine programs now available on cassette to members at £3.50 inc: VAT & p+p — see April/ May issue for details.

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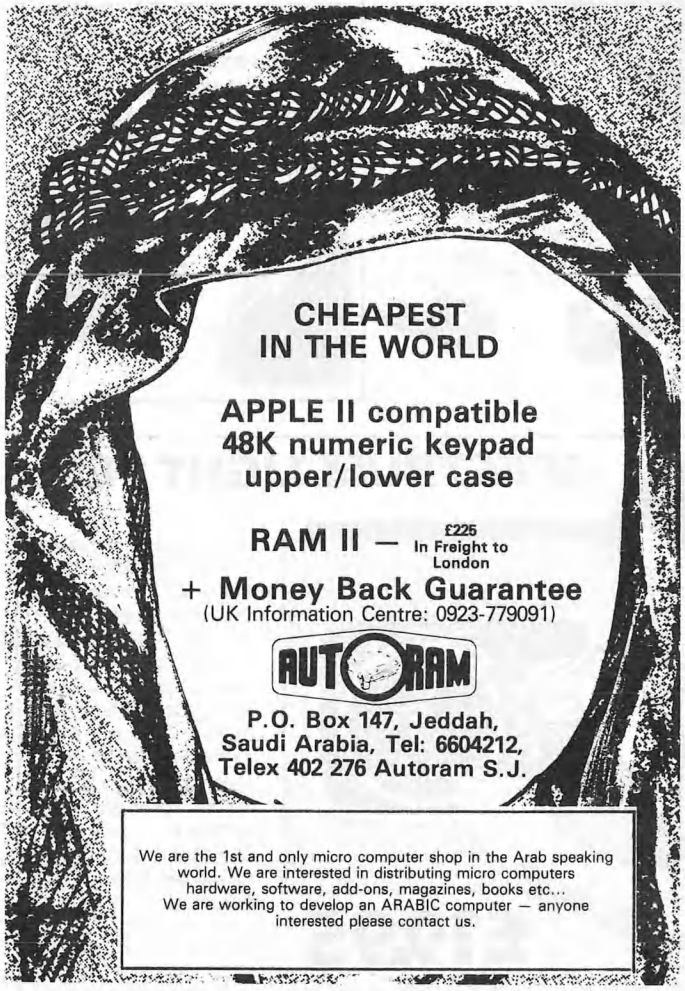

(continued from page 171)

```
420 IF A$="@" THEN BREAK=1
430 IF BREAK=1 AND COUNT<5 AND PPOINT(X,Y)=4 THEN COUNT=COUNT+1:BREAK=0:GOTO 450
440 IF PPOINT(X,Y)=4 THEN GOSUB 480
450 IF PPOINT(X,Y)=1 THEN GOSUB 520
460 PSET(X,Y,3):GOTO 310
470 REM*** CRASH GOSUB *********
480 WALL=WALL+1:X=RND(18):Y=RND(19)
490 PLAY"V31T25505BA£AG£GF£FE£ED£DC£CO4BA£AG£GF£FE£ED£DC£CO3BA£AG£GF£FE£ED£DC£CO
2BA£AG£GF£FE£ED£DC£CO2BA£AG£GF£FE£ED£DC£CO1BA£AG£GF£FE£ED£DC£C"
500 X=X*13.5+4:Y=Y*10+4:RETURN
510 REM**** SCORE GOSUB ********
520 SCORE=SCORE+1
530 PLAY"V31T25505ABCDEFGO4ABCDEFGO3ABCDEFGO2ABCDEFGO1ABCDEFG"
540 IF SCORE=5 THEN PLAY"V31T6L404EGCEO3L8GGABC":GOTO 560 ELSE RETURN
550 REM*** END PAGE ************
560 TIME=TIMER:IF TIME<=STIME AND WALL<=LWALL THEN STIME=TIME:LWALL=WALL
570 CLS:PRINT"SHORTEST TIME ";STIME:PRINT:PRINT"AND LEAST CRASHES ";LWALL
580 PRINT:PRINT:PRINT:PRINT"YOUR TIME ";TIME:PRINT:PRINT"CRASHES AGAINST THE WAL
L ";WALL
590 PRINT:PRINT"ANOTHER GAME (Y/N)"
600 A$=INKEY$
610 IF  A$="Y" THENQQ=0:COUNT=0:WALL=0:BREAK=0:SCORE=0:GOTO 40ELSE IF A$="N" THE
N END
620 GOTO 600
```

Editor of character

Paul Volkaerts,
Maryport,
Cumbria.

VIC-20

THIS POWERFUL and easy-to-use character editor is for the 3.5K Vic-20. It enables you to define or edit 60 characters from the Vic character set. When run, you will be asked to wait about 20 seconds while the Vic initialises the variables and clears some space for your characters.

If you type –1, you will be given a list of the characters currently in memory and then a list of options. If you type any other number between 0 and 59, an eight-by-eight character grid will appear on the screen with a block representation of your character in it and a cursor in the top left-hand corner.

Move the cursor around the grid using the Vic cursor keys and typing plus sign to set a pixel or a minus sign to erase a pixel. When you are satisfied with your character, pressing F1 will enter it and take you to the stage you would be at if you had typed –1 at the start.

The options shown are:

Define — jumps back to the start of the program and asks you to enter a character code to edit
Clear — clears the whole character set
List — lists the character set
Copy — copies one character into another
Flip — turns a character upside down
Invert — reverses a character
Merge — merges a set from tape on to the existing set
Save — saves a set on to tape
Exist — exits from the program.

the Clear command asks you if you are sure that you want to clear the set as a precaution against ruining a day's work. If you wish to load a set from tape normally, first clear and set and then merge a set into memory. After exiting from the program .ew it.

To access the characters, type:

POKE 36869,255

```
 10 POKE52,26:POKE56,26
 20 PRINT"■■■■■■■■■■■■■■■■PLEASE WAIT"
 30 FORA=0TO511:POKE7168+A,PEEK(32768+A):NEXT
 40 FORA=7648TO7679:IFA<7664THENPOKEA,-255*(A>7655):NEXTA:GOTO60
 50 READB:POKEA,B:NEXT:DATA0,8,8,62,8,8,0,0,255,247,247,193,247,247,255,255
 60 R$="":GOSUB1000
 70 PRINT"■■CHARS 0-59 ARE FREE"
 75 PRINT"■TYPING '-1' LISTS SET■"
 80 INPUT"INPUT CHAR CODE";C:IFC<-1ORC>59ORC<>INT(C)THEN80
 85 POKE36869,255:IFC=-1THEN500
 90 R$="■":GOSUB1000
 100 PRINTSPC(3)"■■■┌──────┐"
 110 A$="■■■■│■<<<<<<<<■│"
 120 PRINTA$,A$,A$,A$,A$,A$,A$,A$
 130 PRINTSPC(3)"■└──────┘"
 140 PRINT"■■■■USE CURSOR KEYS TO  POSITION CURSOR.      HIT '+' TO SET PIXEL  O
R  ";
 150 PRINT"■'-' TO ERASE PIXEL■■KEY 'F1' ENTERS CHAR"
 160 PRINT"■■■■■■■■■SPC(13)"■CHAR"C"■■■■■■■=":POKE7918,C:POKE38638,6
 180 S=7816:U=S:P=7168+C*8
 190 FORA=0TO7:B=PEEK(P+A):FORI=0TO7:IF(BAND(2↑I))<>0THENPOKES+A*22+(7-I),61
 200 NEXTI,A
 210 POKEU,62OR(PEEK(U)AND1)
 220 GETA$:IFA$="+"ORA$="-"THEN400
 230 IFA$="■"THEN500
 240 IFA$<>"□"ANDA$<>"■"ANDA$<>"■"ANDA$<>"■"THEN220
 250 A=0:I=0
 260 A=(A$="■")-(A$="■")+22*((A$="□")-(A$="■"))
 280 IFPEEK(U+A)=192ORPEEK(U+A)=221THEN210
 290 POKEU,60OR(PEEK(U)AND1)
 300 U=U+A
 310 GOTO210
 400 A=INT((U-S)/22)+P
 410 I=7-(U-((A-P)*22+S))
 420 POKEU,62:POKEA,PEEK(A)AND(255-(2↑I))
 430 IFA$="+"THENPOKEU,63:POKEA,PEEK(A)OR(2↑I)
 440 GOTO210
 500 POKE36869,255:R$="■":GOSUB1000
 510 PRINT"■■CHARS 0-59 ARE:"
 520 FORA=0TO59:I=7834+A*3:POKEI,A:POKE30720+I,6:NEXT
 530 PRINT"■■■■■■■■■■■■■ HIT ANY KEY TO CONT"
 540 GETA$:IFA$=""THEN540
 550 POKE36869,240:R$="":GOSUB1000:PRINTSPC(7)"■OPTIONS"SPC(15)"──────"
 560 PRINT"■■'1' - DEFINE NEW CHAR '2' - CLEARS SET      '3' - LISTS SET"
 570 PRINT" '4' - COPIES CHAR      '5' - FLIPS CHAR      '6' - INVERTES CHAR"
 575 PRINT" '7' - MERGES SET       '8' - SAVES SET       '9' - EXIT FROM PROG"
 580 PRINT"■  TYPE IN SELECTION"
 660 GETA$:A=VAL(A$):IFA<10RA>9THEN660
 670 IFA=9THENSYS65234
 680 ONAGOTO60,700,500,850,950,900,800,750
 690 STOP
 700 PRINT"□CLEAR ROUTINE          ■SURE (Y/N)?";
 710 GETA$:IFA$="N"THENPRINT"N□":GOTO550
 720 IFA$<>"Y"THEN710
 725 PRINT"Y□"
 730 FORA=7168TO7647:POKEA,0:NEXT:PRINT"CHARS 0-59 CLEARED□":FORA=1TO2000:NEXT:G
OTO550
 750 PRINT"□SAVE ROUTINE          ■"
 760 OPEN1,1,1,"CHAR SET":FORA=7168TO7679:PRINT#1,PEEK(A):NEXT:CLOSE1:GOTO550
 800 PRINT"□MERGE ROUTINE         ■"
 810 OPEN1,1,0,"CHAR SET":FORA=7168TO7679:INPUT#1,I:POKEA,PEEK(A)ORI:NEXT:CLOSE1
:GOTO550
 850 INPUT"□COPY WHICH CHAR      ■■■■■■";C:IFC<0ORC>59ORC<>INT(C)THEN850
```

(continued on page 177)

WINDOW ON ANOTHER WORLD

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Salamander Software

(continued from page 175)

```
860 INPUT"]INTO WHICH CHAR      ██████";B:IFB<0ORB>59ORB<>INT(B)THEN860
870 FORA=0TO7:POKE7168+B*8+A,PEEK(7168+C*8+A):NEXT:GOTO550
900 INPUT"]INVERT WHICH CHAR    █████";C:IFC<0ORC>59ORC<>INT(C)THEN900
910 FORA=7168+C*8TO7175+C*8:POKEA,255-PEEK(A):NEXT:GOTO550
950 INPUT"]FLIP WHICH CHAR     █████";C:IFC<0ORC>59ORC<>INT(C)THEN950
960 I=7168+C*8:FORA=0TO3:B=PEEK(I+A):POKEI+A,PEEK(I+7-A):POKEI+7-A,B
970 NEXTA:GOTO550
1000 PRINT"]"SPC(5);R$"SUPER CHARS","█████r──────────","(C) PACSOFT '83":RETURN
```

On the move

Myles Dunlop,
Buckfastleigh,
Devon.

ORIC

THIS MACHINE-code routine for 48K Oric 1 scrolls the screen from right to left. It uses no subroutines so it can be relocated anywhere in RAM with no changes. I have chosen to locate it in the high-resolution graphics memory.

To load the machine code, enter the program, then type Run. To call the routine type

CALL # 9800

The program in its present form scrolls the whole screen except the status line or the final column, and does not touch the protected columns to the left of the screen. To include the protected columns in the scroll, type

POKE # 9827,2

for the protected column to the right, or

POKE # 9827,1

for both. Address 983D hex holds the number of lines +1 to be affected and this can also be altered.

```
5 REMFOR £ READ HASH CHARACTER
10 A=£9800
20 READB:IFB=999THENEND
30 POKEA,B
40 A=A+1
50 GOTO20
60 DATA£A9,128,£85,128,£A9,187,£85,129
70 DATA£A9,1,£85,130,£A5,128,£85,131
80 DATA£A5,129,£85,132,£A6,130,£A5,131
90 DATA£18,£69,40,£85,131,£A5,132
100 DATA£69,0,£85,132,£CA,£D0,240
110 DATA£A0,3,£B1,131,£88,£91,131,£C8
120 DATA£C8,£C0,39,£D0,245,£A9,32
125 DATA£91,131,£88,£91,131
130 DATA£A6,130,£E8,£E0,28
140 DATA£F0,5,£86,130,£18,£90,198,£60
150 DATA999
```

Puzzling terrestrial

Paul Marzetti,
Addiscombe,
Surrey.

CBM-64

IN THIS PROGRAM for the Commodore 64, your aim is to recreate a picture of ET. The game is based on a hand-held puzzle in which you have to order the numbers 1 to 15 by moving small squares into an empty space.

When you run the program, after about five seconds eight sprites will emerge from a point to the left of your TV screen, moving outwards until they eventually form our picture of ET. Since all eight sprites are used in this program, playing takes place on a three-by-three grid — one is the empty square.

You are then presented with the instructions which are printed on to the screen, letter by letter, using the string-handling function Mid$. The computer then shuffles up the elements of the picture and re-displays the sprites in their new positions on the screen.

You can only move the elements of the picture into the empty square and even then, only if they are adjacent. You must try to rearrange the picture in as few moves as possible. The grid is set up as follows:

1 2 3
4 5 6
7 8 9

Since initially the vacant cell is always 9, your first move is always a 6 or an 8. Take care when typing in the sprite data as one omission can corrupt the entire display.

```
1 POKE 53280,12:POKE 53281,9
2 DIMA$(11)
3 C=11
4 VC=9
5 PRINT"]"
10 V=53248
20 POKEV+21,255:POKEV+23,255:POKEV+29,255
30 FORE=200TO207:POKE2040+E-200,E:FORD=64*ETO64*E+62:READS:POKED,S:NEXT:POKEV+3
9+E-200,C:NEXT
40 PRINT
41 FORD=1TO16:PRINT"     ]]                 ":NEXT
42 PRINT"██████████████████████████████  "
99 POKEV+8,112:POKEV+9,106
100 FORD=105TO64STEP-1
110 POKE V,D:POKEV+1,D
115 POKE V+2,112:POKEV+3,D
120 POKEV+4,160+64-D:POKEV+5,D
130 POKE V+6,D:POKE V+7,106
140 POKEV+10,160+64-D:POKEV+11,106
150 POKE V+12,D:POKEV+13,106+106-D
160 POKE V+14,112:POKEV+15,106+106-D
190 NEXT
215 PRINT CHR$(14)"█";
216 FORD=1TO17
217 READ A$
220 PRINT"███████████████████████████";
221 FORL=1TOLEN(A$):PRINTMID$(A$,L,1);:FORH=1TO30:NEXT:NEXT:PRINT
240 NEXT
245 POKE 198,0
250 GET A$:IFA$<>CHR$(13)THEN250
255 PRINT"█";
260 FORD=1TO23:PRINTSPC(24)"                ":FORB=1TO30:NEXT:NEXT
265 PRINT"█";
270 FORD=1TO13
277 READ A$
280 PRINT"███████████████████████████";
290 FORL=1TOLEN(A$):PRINTMID$(A$,L,1);:FORH=1TO30:NEXT:NEXT:PRINT
300 NEXT
305 FORL=1TO2000:NEXT:FORD=PEEK(V+14)TOPEEK(V+14)+48STEP.25:POKEV+14,D:NEXT
309 PRINT"██████████████████████████████┐└¯♥♥ ─┐ /─/":POKE 198,0
310 GET A$:IFA$<>CHR$(13)THEN310
320 PRINT"█";
330 FORD=1TO23:PRINTSPC(24)"                ":FORB=1TO30:NEXT:NEXT
350 FORD=1TO11:READA$(D):NEXT:A=INT(RND(1)*11)+1
360 FORD=0TO7:A(D)=(VAL(MID$(A$(A),D+1,1))-1):NEXT
370 FORD=1TO9:READB(D):NEXT
380 POKE V+21,0
390 PRINT"███████████████████████████  Γ./ HERE COMES THE SCRAMBLED PICTURE"
400 POKEV+A(0)*2,64:POKEV+A(0)*2+1,64
401 POKEV+A(1)*2,112:POKEV+A(1)*2+1,64
402 POKEV+A(2)*2,160:POKEV+A(2)*2+1,64
403 POKEV+A(3)*2,64:POKEV+A(3)*2+1,106
404 POKEV+A(4)*2,112:POKEV+A(4)*2+1,106
405 POKEV+A(5)*2,160:POKEV+A(5)*2+1,106
406 POKEV+A(6)*2,64:POKEV+A(6)*2+1,148
407 POKEV+A(7)*2,112:POKEV+A(7)*2+1,148
410 C=0:FORD=0TO7:C=C+2↑A(D):POKEV+21,C:FORH=1TO200:NEXT:NEXT
411 PRINT"███████████████████████████
412 PRINT"█████"SPC(30)"1  2  3██████████4  5  6██████████7  8  9"
420 PRINT"████████████████████████████████NOVE"
430 GET M$:M=VAL(M$):IFM$=""THEN430
435 IFM<1THEN430
440 M1=VAL(LEFT$(STR$(B(VC)),2))
441 M2=VAL(MID$(STR$(B(VC)),3,1))
442 M3=VAL(MID$(STR$(B(VC)),4,1))
443 M4=VAL(RIGHT$(STR$(B(VC)),1))
445 IF M<>M1 AND M<>M2 AND M<>M3 AND M<>M4 THEN 430
450 PRINT"█████████████████████████████████     █":IFM<4THENY=64
451 IFM>3ANDM<7THENY=106
452 IFM>6THENY=148
453 IFM=1ORM=4ORM=7THENX=64
454 IFM=2ORM=5ORM=8THENX=112
455 IFM/3=INT(M/3)THENX=160
456 IFM=VC+3THENGOSUB800
457 IFM+3=VCTHENGOSUB850
458 IFM=VC+1THENGOSUB900
459 IFM+1=VCTHENGOSUB950
470 A(VC-1)=A(M-1):A(M-1)=99
475 C=0
480 FORD=1TO8:IFA(D)=DTHENC=C+1
490 NEXT
500 IFC=7THEN2000
510 VC=M
515 M5=M5+1:PRINT"████████████████████████████████████████████MOVES██";M5
520 GOTO 420
800 REM **UP**
805 FORL=YTOY-42STEP-1:POKEV+A(M-1)*2+1,L:NEXT
820 RETURN
```

(continued on page 179)

CAMEL PRODUCTS

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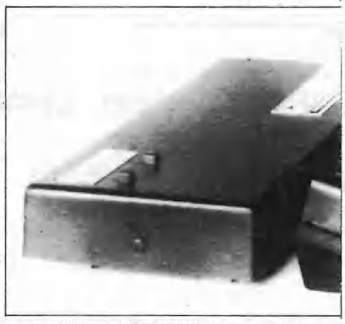

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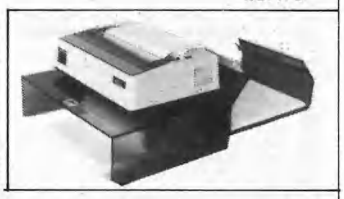

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On the **ZX81** you can create assembly language source tapes and assemble them into machine code using **AM-ZXEDIT** and **AMAZON**, running under the control of AM-ZXMON. AMAZON can assemble programs of up to 6K in size at one time, and accepts user symbols, hex., decimal, and string constants, and the full Zilog mnemonics.

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On the Spectrum **AM-EDIZON** is a combined editor/assembler with all the facilities you need to assemble and save machine code programs fast. It can be used to create, edit, and assemble up to 1500 lines of assembly language text at one time & produce up to 4½ K of machine code. The code and source program can be saved on tape for later use or for merging with other programs. Output tapes can be added to BASIC programs by the LOAD CODE command. Code can be assembled to run at any address, at a speed of 800 lines/minute.

Spectrum version £10.00

AM-ZXCONV will load tapes created by the ZX81 versions of AM-ZXMON or AMAZON, and load them into the Spectrum; the easy way to transfer machine code from one to the other.

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(continued from page 177)

```
 850 REM *DOWN*
 855 FORL=YTOY+42:POKEV+A(M-1)*2+1,L:NEXT
 870 RETURN
 900 REM *LEFT*
 905 FORL=XTOX-48STEP-1:POKEV+A(M-1)*2,L:NEXT
 920 RETURN
 950 REM *RIGHT*
 955 FORL=XTOX+48:POKEV+A(M-1)*2,L:NEXT
 970 RETURN
 999 REM ****SPRITE 1****
1000 DATA0,0,0,0,0,31,0,1,224,0,6,0,0,24,15,0,96,127,0,65,255,0,135,255,1,31,25
5
1001 DATA2,63,252,4,63,252,4,127,252,4,255,128,8,254,15,8,254,127,16,254,187,19
1002 DATA252,159,35,248,143,39,248,112,47,240,15,35,224,0
1003 REM ****SPRITE 2****
1004 DATA0,0,0,224,0,0,30,0,127,1,255,128,92,0,16,252,198,17,255,241,10,255,248
1005 DATA146,255,252,212,63,254,32,31,255,143,31,255,255,231,255,255,211,255,25
5
1006 DATA208,16,68,216,122,68,144,154,137,17,113,2,226,134,18,21,27,41,42,36,19
6
1007 REM ****SPRITE 3****
1008 DATA0,0,0,0,0,0,128,0,0,103,0,0,24,240,0,0,28,0,0,3,0,31,128,192,255,248,3
2
1009 DATA255,252,32,255,252,16,255,254,16,192,126,8,128,63,8,63,31,4,220,158,4
1010 DATA46,94,4,102,126,8,62,78,8,156,192,8,127,0,136
1011 REM ****SPRITE 4****
1012 DATA32,230,0,35,1,192,34,0,63,33,128,0,16,120,28,16,7,225,10,0,1,9,147,14,
4
1013 DATA100,8,2,24,16,1,32,16,0,192,32,0,54,192,0,9,0,0,4,3,0,2,132,0,1,104,0,
0
1014 DATA145,0,0,65,0,0,126,0,0,72
1015 REM ****SPRITE 5****
1016 DATA4,68,2,132,137,154,73,40,180,137,36,9,145,65,0,18,65,32,34,130,32,36,1
32
1017 DATA24,73,0,4,74,0,0,74,3,142,144,7,255,145,30,254,144,248,62,16,16,62,75,
11
1018 DATA158,160,134,124,32,64,24,16,56,0,8,7,0,2,0,14
1019 REM ****SPRITE 6****
1020 DATA0,0,136,0,65,136,14,50,48,1,140,80,192,64,96,48,48,160,8,9,64,4,6,64,2
,0
1021 DATA128,67,33,0,34,198,0,18,24,0,20,96,0,36,128,0,43,0,0,68,0,0,4,0,0,24,0
,0
1022 DATA32,0,0,64,0,0,128,0,0
1023 REM ****SPRITE 7****
1024 DATA0,0,38,0,0,33,0,0,32,0,0,144,0,3,156,0,31,18,3,190,9,31,166,8,30,3,4,2
4,3
1025 DATA4,24,3,7,27,131,4,31,129,132,14,1,162,12,97,130,12,232,3,15,192,2,15,0
,1
1026 DATA4,0,1,0,0,1,0,0,1
1027 REM ****SPRITE 8****
1028 DATA1,128,17,0,120,225,248,7,2,6,0,12,1,255,240,0,64,0,128,32,0,65,32,0,62
1029 DATA32,0,0,64,0,0,64,0,192,64,0,35,64,0,28,64,0,0,32,0,128,32,0,112,32,0,8
1030 DATA160,0,7,32,0,0,16,0,0,16,0
1040 DATA "■OUR OBJECTIVE","IS TO RECREATE","THIS PICTURE ","OF ■.!."
1050 DATA ,"■IE IS MADE UP",OF A GRID OF,3X3 SPRITES,YOU CAN MOVE
1060 DATAEACH CELL INTO,THE VACANT ONE,,"■OU DO THIS BY","TYPING THE /0."
1070 DATAOF THE CELL YOU,WANT TO MOVE
1080 DATA"■■L■■ ■■ ■■"
1090 DATA"■HE GRID IS SET","UP LIKE THIS :-"
1100 DATA,"■ 1 2 3",," 4 5 6",," 7 8 9"
1110 DATA,,,"■■O TYPING 8","WILL DO THIS"
1120 DATA82167534,17654238,85476213,32856471,38764152,41257368,64132875,6187342
5
1130 DATA57638241,84657312,28654137
1140 DATA0024,0135,0260,0157,2468,0359,0480,0579,0680
2000 POKE 54296,15
2010 A1=54291:R1=54292:A2=54277:R2=54278
2020 H1=54287:L1=54286:W1=54290:H2=54273:L2=54272:W2=54276
2040 POKEA1,102:POKER1,0:POKEA2,96:POKER2,0
2100 READH,L,D
2103 IFH=0THENPOKER1,14:POKE54296,0:POKEH1,0:POKEL1,0:POKEH2,0:POKEL2,0:END
2104 POKEW1,0:POKEW2,0
2105 POKEW1,17:POKEW2,33
2106 POKEH1,0:POKEH1,H:POKEH2,0:POKEH2,H
2110 POKEL1,0:POKEL1,L:POKEL2,0:POKEL2,L:FORE=0TO7*D:POKER2,136:POKER1,136:NEXT
2120 GOTO 2100
2200 DATA34,75,6,51,97,6,45,198,1,43,52,1,38,126,1,43,52,1,34,75,6,25,177,10
2210 DATA28,214,6,57,172,6,51,97,1,48,127,1,43,52,1,48,127,1,38,126,6,64,188,10
2220 DATA38,126,6,68,149,6,64,188,1,57,172,1,51,97,1,45,198,1,40,200,6,34,75,10
2221 DATA40,200,6,34,75,6,68,149,4,76,252,2,64,188,12
2225 DATA68,150,6,102,196,6,90,99,1,86,52,1,76,126,1,86,52,1,68,75,6,50,177,10
2226 DATA56,214,6,114,172,6,102,97,1,96,127,1,86,52,1,96,127,1,76,126,6,128,188
,10
2227 DATA76,126,6,136,149,6,128,188,1,114,172,1,102,97,1,90,198,1,80,200,6,68,7
5,10
2230 DATA80,200,6,68,75,6,136,149,4,152,252,2,128,188,12,136,149,6,204,194,6
2240 DATA192,254,6,152,252,6,136,149,12
2300 DATA 0,0,0
```

Data storage

R L Jones and
D J Pengilley,
Bath,
Avon.

LYNX

THE LYNX BASIC has one major disadvantage when it comes to storing and retrieving information on to tape — it does not appear to have any real file-handling capabilities. This short program was written to overcome the problem and can be used as the basis for your own data-handling programs.

The program uses the LCTN function to enable data to be Poked into Data statements already contained at the end of the program. The data to be stored is entered in the form of a string — line 140. Then each individual character within the string is converted to its ASCII code and Poked into the Data statement at the line number specified after LCTN in line 170.

The program gives the option of saving the entire program or just the Data statements. If just the Data statements are required then the program will delete itself. The user will then have to save them in the usual way. When the information is required for use by another program the Append function can be used.

The beauty of the program is that the Data statements can be filled under program control and the operator does not need much experience of computers.

```
 10 CLS
 20 PRINT @ 30,60;"ENTER DATA......1"
 30 PRINT @ 30,70;"RETRIEVE DATA...2"
 40 PRINT @ 30,80;"EXIT PROGRAM....3"
 50 PRINT @ 30,100;"ENTER OPTION..(1 TO 3)"
 60 LET R$=GET$
 70 IF R$="1" THEN GOTO 110
 80 IF R$="2" THEN GOTO 520
 90 IF R$="3" THEN END
 100 GOTO 60
 110 CLS
 120 FOR N=0 TO 4
 130 PRINT "ENTER DATA"
 140 INPUT A$
 150 FOR X=1 TO LEN(A$)
 160 LET B$=MID$(A$,X,1)
 170 POKE LCTN(10000+N)+X-1,ASC(B$)
 180 NEXT X
 190 NEXT N
 200 CLS
 210 PRINT @ 30,60;"SAVE DATA ONLY.......1"
 220 PRINT @ 30,70;"SAVE WHOLE PROGRAM...2"
 230 PRINT @ 30,90;"ENTER OPTION..(1 OR 2)"
 240 LET X$=GET$
 250 IF X$="1" THEN GOTO 280
 260 IF X$="2" THEN GOTO 450
 270 GOTO 240
 280 CLS
 290 VDU 24
 300 INK 2
 310 PRINT "WARNING!"
 320 INK 7
 330 PRINT "THIS WILL ERASE PROGRAM."
 340 VDU 25
 350 PRINT @ 30,60;"CONTINUE...(Y OR N)"
 360 LET X$=GET$
 370 IF X$="Y" THEN GOTO 400
 380 IF X$="N" THEN GOTO 10
 390 GOTO 360
 400 CLS
 410 PRINT "TYPE ";CHR$(34);"SAVE ";CHR$(34);
     "FILENAME";CHR$(34);" ";CHR$(34)
 420 PRINT "THEN PRESS PLAY AND RECORD ON TAPE,"
 430 PRINT "PRESS ";CHR$(34);"RETURN";CHR$(34);
 440 DEL 10,9999
 450 CLS
 460 VDU 24
 470 PRINT "SAVING PROGRAM"
 480 VDU 25,7
 490 SAVE "PROGRAM"
 500 VDU 7
 510 GOTO 10
 520 CLS
 530 RESTORE
 540 FOR X=1 TO 5
 550 READ X$
 560 PRINT X$
 570 NEXT X
 580 PRINT @ 10,200;"PRESS SPACE BAR TO CONTINUE"
 590 LET X$=GET$
 600 IF ASC(X$)=32 THEN GOTO 10
 610 GOTO 590
 9999 END
 10000 DATA ###################
 10001 DATA ###################
 10002 DATA ###################
 10003 DATA ###################
 10004 DATA ###################
```

Time at the top

P Brett,
Wellingborough,
Northamptonshire.

VIC-20

THIS PROGRAM for the unexpaned Vic-20 generates a display of a 24-hour clock at the top of the screen while other programs are running. It takes 256 bytes from the top of memory and diverts the interrupt.

The Restore key is disabled, to prevent losing the new interrupt vector, and the Basic loader newed. The program should be typed in carefully and saved before running. Each line has an individual check at the end and the whole program has a check to make sure no lines have been missed out.

The current time is stored in: 673, one-sixtieths of a second; 674 seconds; 675 minutes; and 676 hours.

```
 5 PRINT"■■";
 10 POKE56,29:POKE52,29:CLR:M=29*256:C=2
 20 READA$
 25 IFA$="END"THEN100
 26 READCO
 40 FORCC=1TOLEN(A$)STEP2
 50 B$=MID$(A$,CC,2)
 60 A=ASC(B$)-48:B=ASC(RIGHT$(B$,1))-48:N=B+7*(B>9)-(C=2)*(16*(A+7*(A>9)))
 70 POKEM,N:M=M+1:T=T+N:TT=TT+N:NEXT
 80 IFT<>COTHENPRINT"ERROR IN LINE"PEEK(63)+256*PEEK(64):END
 90 T=0:GOTO20
 100 DATA"ADA1021869018DA1",768
 105 IFTT<>17122THENPRINT"ERROR IN DATA":END
 110 DATA"02C93CD03BA9008DA102",1003
 120 DATA"ADA2021869018DA202",772
 130 DATA"C93CD029A9008DA202",984
 140 DATA"ADA3021869018DA302C93CD017",1266
 150 DATA"A9008DA302ADA402186901",944
 160 DATA"8DA402C918D005A9008DA402",1221
 170 DATA"A200ADA40220761DA9BA9D001EE8",1454
 180 DATA"ADA30220761DA9BA9D001EE8",1291
 190 DATA"ADA20220761DA200A906",853
 200 DATA"9D0096E8E008D0F64CBFEA",1726
 210 DATA"48A9008DA50268C909F0161003189011",1329
 220 DATA"18E90948ADA5021869018DA502684C7E1D",1451
 230 DATA"48ADA5021869B09D001EE8681869B09D001E",1732
 240 DATA"E860",328
 250 DATAEND
 260 M=678
 270 READC:IFC=999THEN290
 280 POKEM,C:M=M+1:GOTO270
 290 DATA120,169,0,141,20,3,169,29,141,21,3,88,96,999
 300 POKE37150,2:SYS678
 310 INPUT"■■HOURS";H
 315 POKE676,H
 320 INPUT"■■MINUTES";M
 325 POKE675,M
 330 INPUT"■■SECONDS";S
 340 POKE674,S:POKE673,0
 350 PRINT"■■■■";
 360 NEW
```

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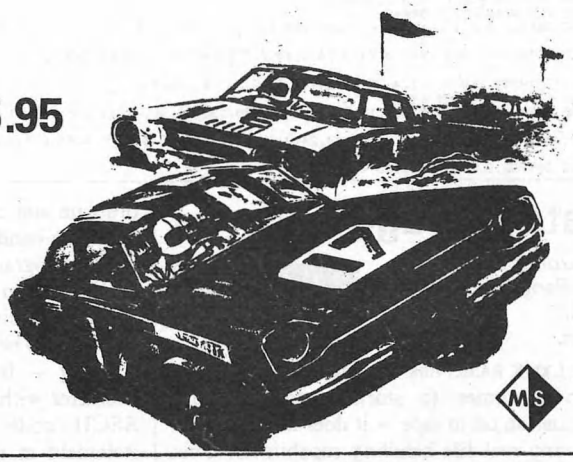

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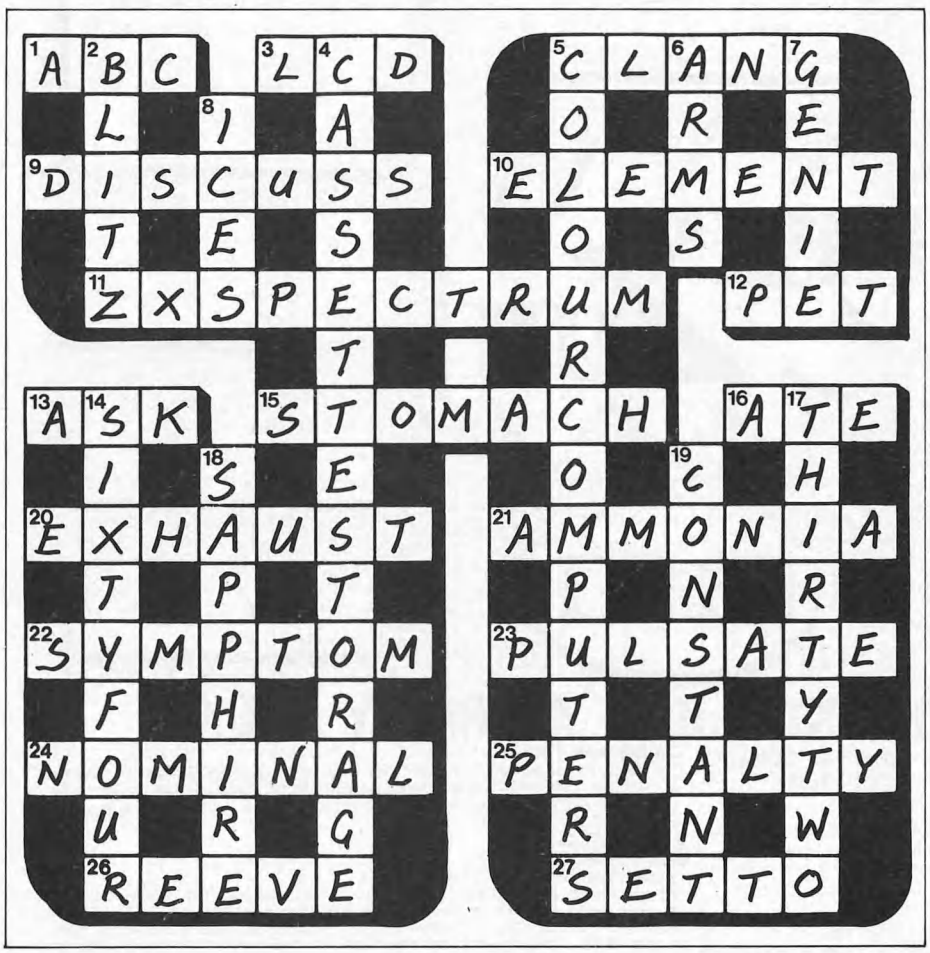
COMPETITION CORNER

A £15 book token will be awarded to the first correct solution drawn from the competition bag. All entries must be at the *Your Computer* offices by the last working day in March. The name of the winner, the solution, and a competition report will be published in the May, 1983 issue of *Your Computer.*

If you want to set a competition for Competition Corner, remember that the simplest solution should be calculable by a short program rather than by any other form of reckoning.



TRINARY TRIBULATION

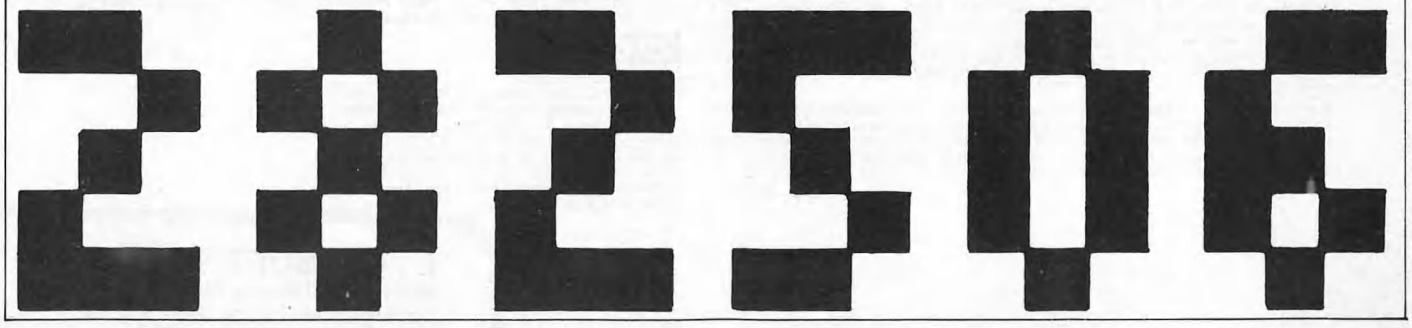
BY ANTHONY ROBERTS

COMPETITION CORNER has got tired of binary computers — so we have developed the first trinary machine. Each "trit" has three states; 0, 1 and 2 — only three trits are required to store the entire alphabet, as you can see.

Numbers are held in just plain trinary — you can only separate numbers from letters by their context, just as in a binary computer.

As usual with Competition Corner, things do not always work too well, and our new computer does not always get the context right. It has just displayed — in ordinary decimal — the number illustrated. The context, however, is wrong: what number should it have displayed?

A = 001	F = 020	K = 102	P = 121	U = 210
B = 002	G = 021	L = 110	Q = 122	V = 211
C = 010	H = 022	M = 111	R = 200	W = 212
D = 011	I = 100	N = 112	S = 201	X = 220
E = 012	J = 101	O = 120	T = 202	Y = 221
				Z = 222



Competition results

THE NATION'S workforce needs portables — or so one might think after reading the large number of entries for the May competition. As a prize we offered Texas Instruments' portable computer, the Texas CC-40. Contestants maintained they would use it in a variety of situations:"It will allow me to work in places other engineers can't compute", wrote R Bailey, and D Bancroft suggested that "Each boring BR journey would become a briefcase workspace", a point echoed by R Wright's "I'm a small commuter who needs a small computer". "From Texas to Djibouti this compact cutie will do its duty" was the way R J Evans put it.

We awarded the prize to M O'Sullivan, 18 Caledonian Place, Edinburgh, EH11 2AP, who completed the sentence "I think the Compact Computer will help me in my work because . . ." with "it's got a Texas-sized brain in the byte-sized package".

Mrs Allemand was again in the running with "It's the best little storehouse in Texas" and, still on the Texan theme, L Dicks gave us the tuneful "parts are light — ROM's all right — deep in the heart of Texas".

Among the other eye-catching entries were P Connolly's "while it does the number-crunching I could enjoy more leisurely lunching" and P Lovett's confident "its compact, stylish, powerful and versatile — like me".

By a strange coincidence solving the Hall of the Troll problem involved finding an Armstrong number - the same problem as was set in the troll's burrow if you start off with a number whose digits taken one at a time and cubed add up to the original number. The number of diamonds picked up is equal to the sum of the square of the digits.

There are five such numbers — 1, 153, 370, 371, 407 — and you get the most diamonds by squaring the digits of 407 to get 65.

The £15 book token goes to M Bassett 26, Falconwood Court, Montpelier Row, Blackheath, London SE3, whose entry was the first to be picked out of the competition bag. For a program to find Armstrong Numbers, see this month's First Bytes competition report.

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VIC 20

LASERZONE (8K+) NEW J

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ABDUCTOR J

A classic new space game! ZAP the swirling alien hordes before they ram you — and abduct your humanoids! Survive the assault for long enough and you'll get an extra stage on your spaceship with double firepower! Awesome unexpanded Vic Action. **£6.00 + 50p P&P.**

GRIDRUNNER J

Finally, true arcade quality on the unexpanded VIC! Shoot down the segmented DROIDS invading the grid. Beware of the pods and zappers! The awsome speed, sound and graphics gives you the best blast available for unexpanded Vic. **£6.00 + 50p P&P.**

ANDES ATTACK (8K) J

Your spacecraft must attack the descending aliens and frustrate their evil intent. Fly your Ramjet fighter over the Andes mountain range and protect your llamas from kidnap by hostile UFOS. Features 5 kinds of UFO, controls include up, down, reverse, fire, thrust and smart bomb. Entirely in machine code. Requires 8K expansion and joystick. **£8.00 + 50p P&P.**

TRAXX M/C (8K + EXPANSION) J

This is VIC 20 cross breed between the now famed 'Packman' and the game 'Quix'. All in machine code, fast and fun with joystick controls, uses Hi-Res colour graphics. 8K or larger expansion needed. **Only £6.00 + 50p P&P complete with instructions.**

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ATTACK OF THE MUTANT CAMELS J

Planet earth needs you! Hostile aliens have used genetic engineering to mutate camels from normally harmless beasts into 90 foot high, neutronium shielded, laser-spitting death camels!! Can you fly your tiny, manoeuvrable fighter over the mountainous landscape to weaken and destroy the camels before they invade the human stronghold! You must withstand withering laser fire and alien UFOs. Game action stretches over 10 screen lengths and features superb scrolling, scanner, 1/2 player actions and unbelievable animation! Play this game and you'll never be able to visit a zoo again without getting an itchy trigger finger! Awesome m/c action! **£8.50 + 50p P&P.**

ROX-64 K

Rox is a challenging game involving the defence of your lunar base from a deadly meteor shower. Rox-64 includes amazing sprite graphics displays and spacy sound effects, and an awesome 'mothership' display if you win the game. Top 10 scores are tabled along with their names. This program shows just what can be achieved using only Commodore-64 basic. Study the listing and learn how to use sprites and sound on this outstanding machine. **£4.95 + 50p P&P.**

GRIDRUNNER 64 J

The No. 1 best game for the Vic has been improved for your COMMODORE 64! Gridrunner is a smash hit in the USA. Now experience the lightning-fast challenge of the grid on the 64. Features 31 skill levels and excellent sound and graphics. Sore trigger finger *free* with every game! **£8.50 + 50p P&P.**

SPECTRUM

GRAPHICS CREATOR (16K)

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BOMBER (16K) K

Yes, a full feature version of the popular game 'Blitz', supplied for the 16K or 48K Spectrum. **For only £2.95 + 50p P&P.**

HEADBANGER (48K) NEW K

Colourful new game starring Chico the headbanger who you must guide to riches through an increasing shower of heavy metal. Gain bonuses for headbanging but be sure to take an aspirin when the pain gets too much! Basic + m/c to speed up action. Great graphics, nice animation. Will even drive William Stuart system's voice synthesiser to produce speech output. Can you attain the grade of 'Rocker Class One' or will you be "Barry Manilow Class 5"? Start headbanging to-day and find out. **£4.95.**

SUPERDEFLEX (48K) NEW K

Bounce 'Sid', the space invader, around the screen into the power pods, keeping away of course from the devil who chases you around the screen. Steer with your Deflex shields, but beware the mines or you may be buried alive! Superb graphics and fantastic sound on the 48K Spectrum only. **Only £4.95 on cassette + 50p P&P.**

ATARI 400-800

GRIDRUNNER NEW J

Now play the best selling VIC/C64 game on your ATARI 400/800. Any memory size (16-48K). Basic cartridge *not* required — 100% machine code autoboot tape. Play this awesomely fast and addictive game on your Atari. **For only £8.50.**

TURBOFLEX K

Superb ultra-fast and totally new ball game. Uses ATARI's unique features to the full. Incorporates superb colour/sound effects and uses Player/Missile graphics. Tables top 10 scores along with Scorer's name. **£6.00+50p P&P.**

ZX81

CENTIPEDE (16K)

the ORIGINAL game from the ORIGINAL author. This is the identical program to that being sold by other companies for three times our price. The game has received ecstatic reviews in the computing press. Program has 20 speed levels and ever increasing Centipede hordes. Tables top 10 scores and names. Why wait to pay more? **Only £1.95 + 50p P&P.**

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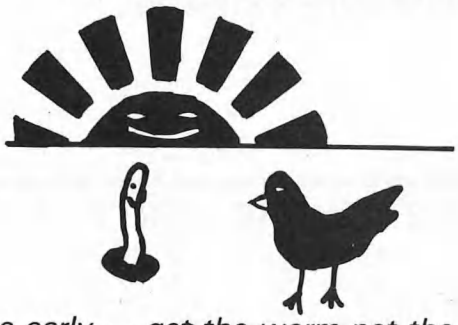

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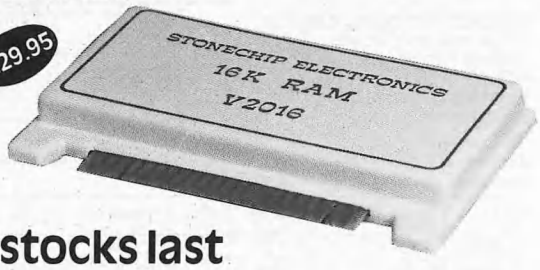

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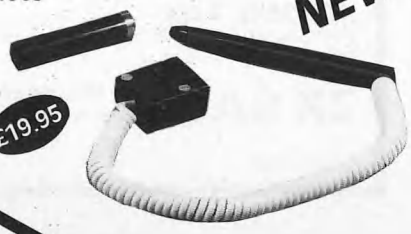

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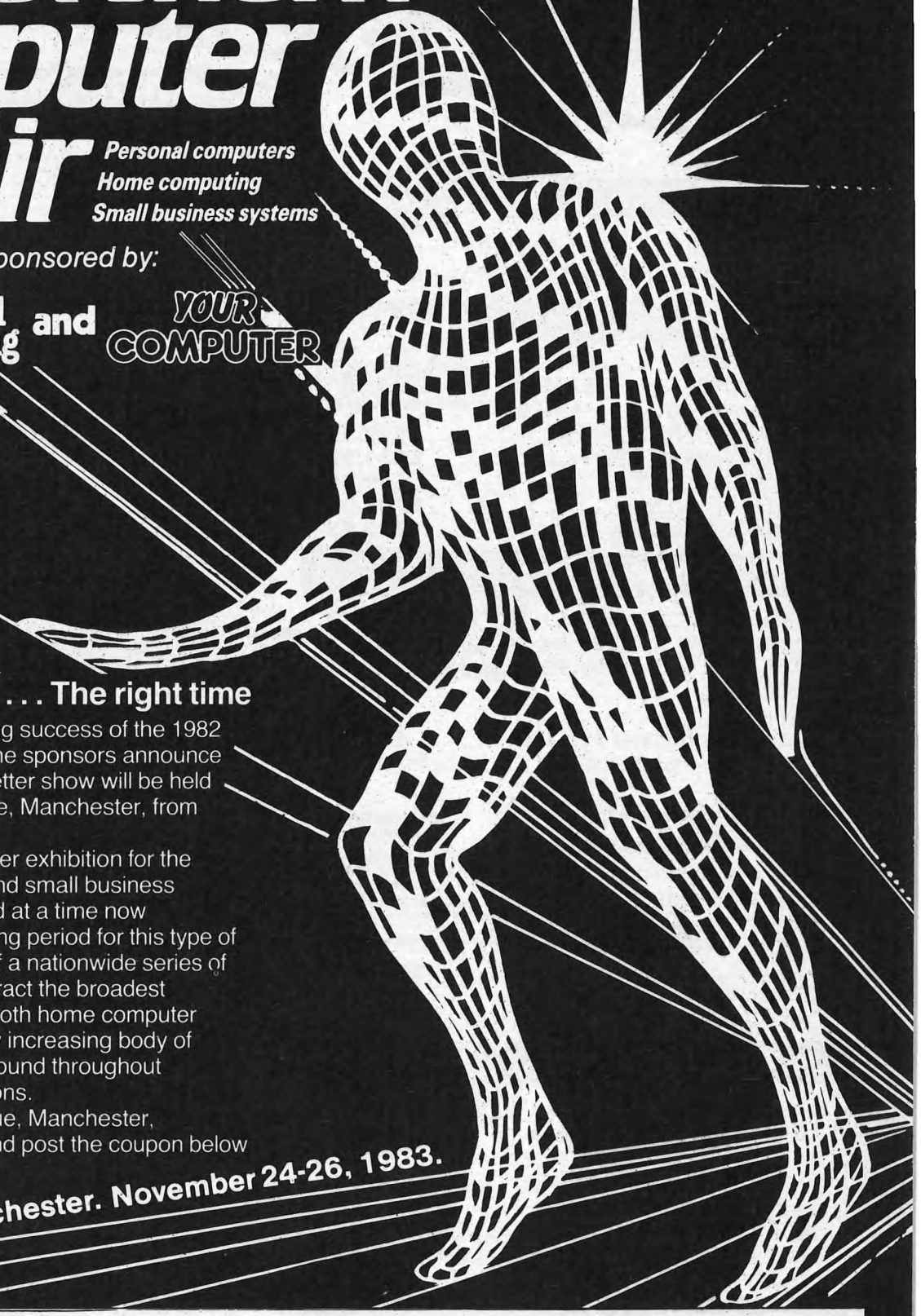

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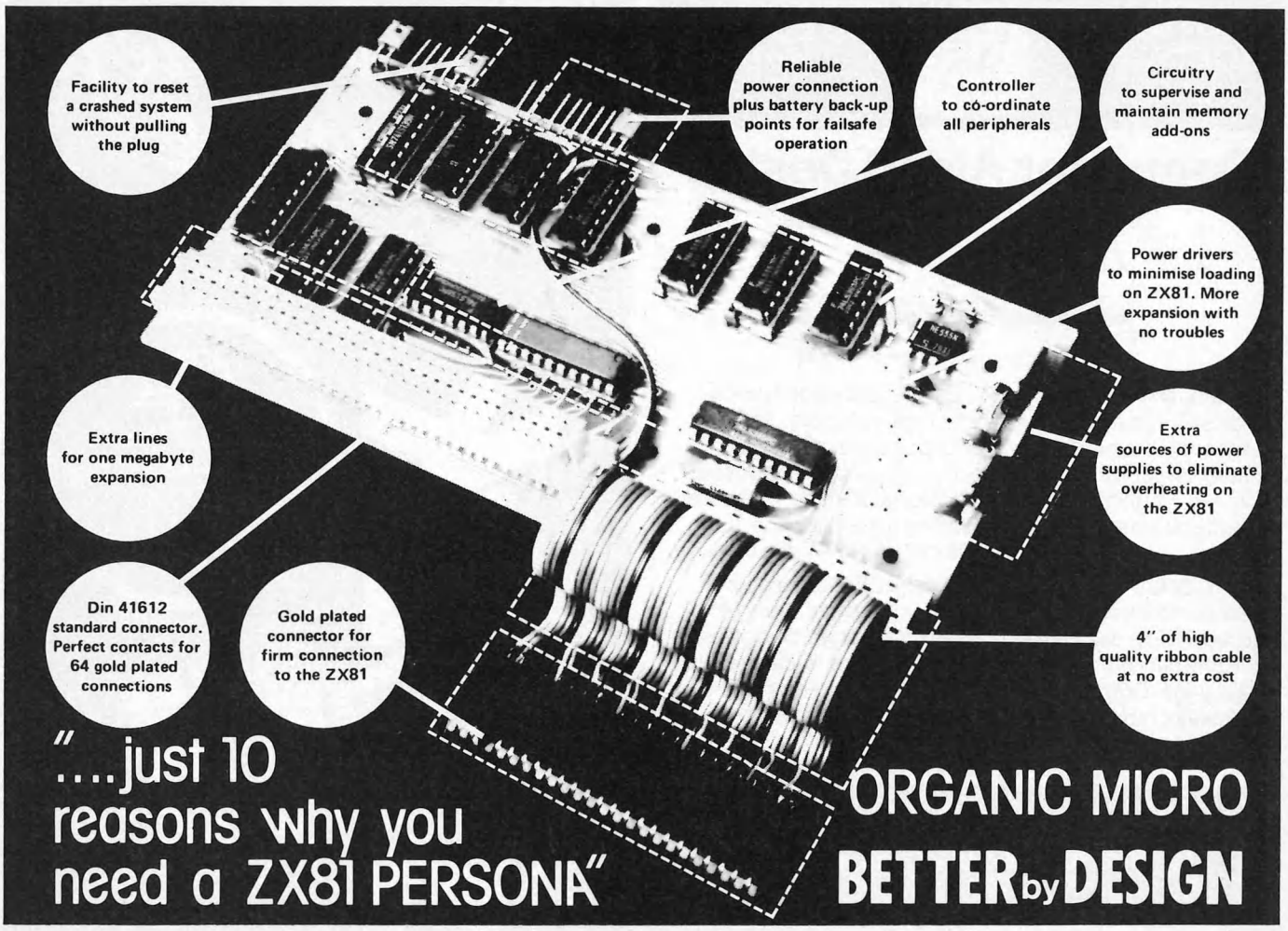

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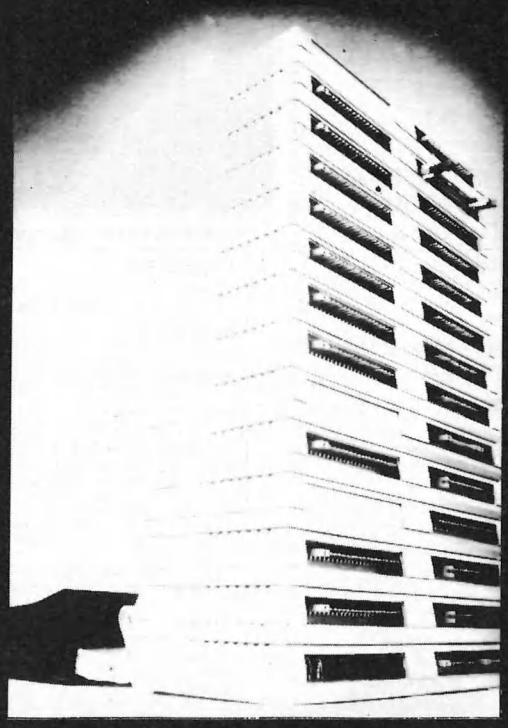

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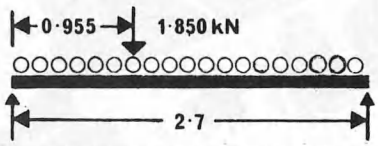

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LEARNABLE
Colour Genie even comes with 2 manuals. A beginner's guide, and one to take you through the first steps of BASIC, the English 'shorthand' that the computer understands (shown here with optional joystick controllers).

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Add more than 40 graphic, arithmetic and other functions. You can see the power behind Colour Genie.

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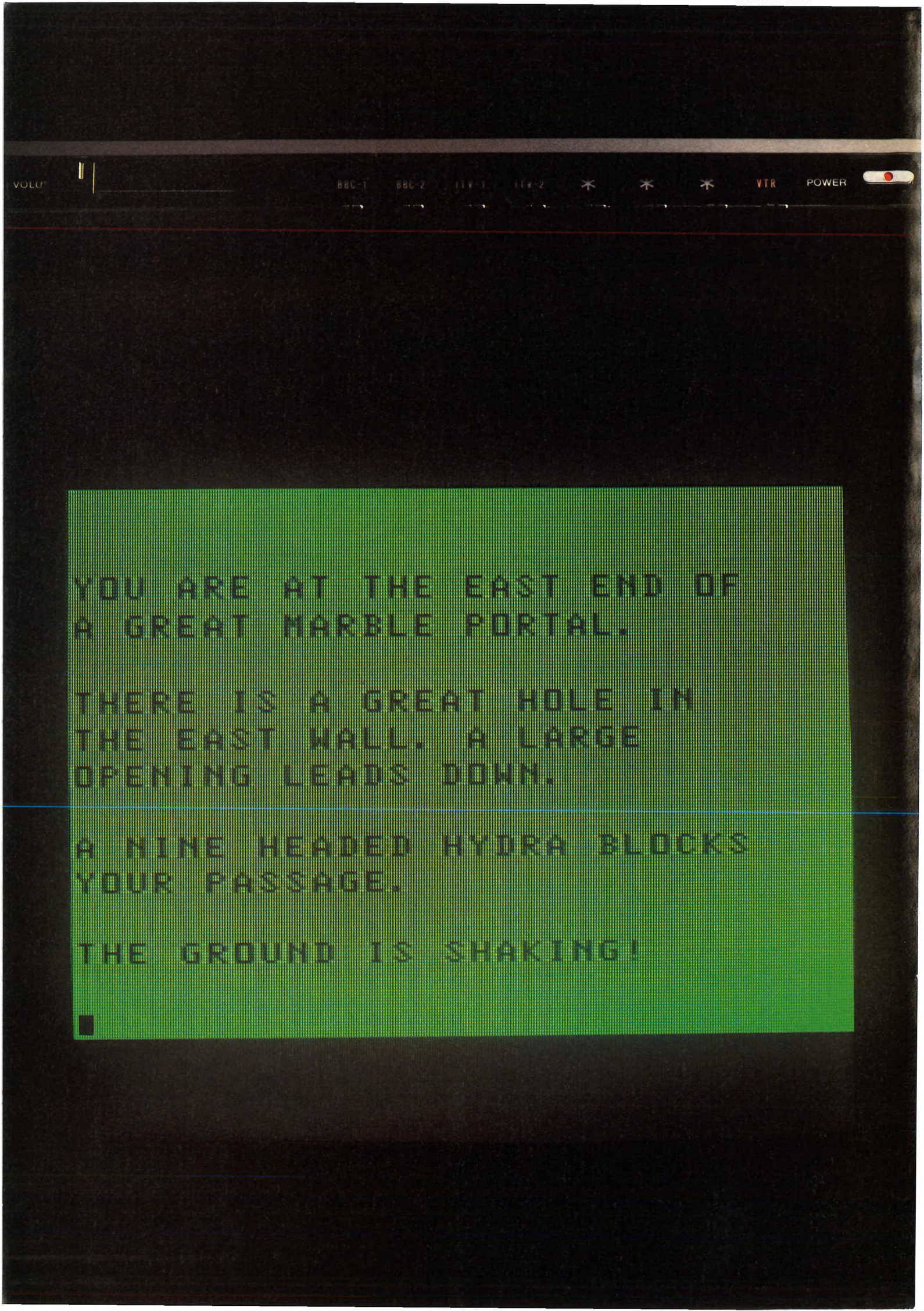
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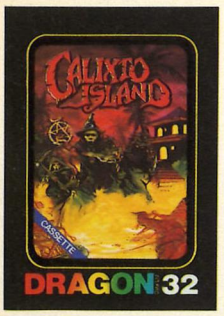
POWER
YOU ARE AT THE EAST END OF
A GREAT MARBLE PORTAL.
THERE IS A GREAT HOLE IN
THE EAST WALL. A LARGE
OPENING LEADS DOWN.
A NINE HEADED HYDRA BLOCKS
YOUR PASSAGE.
THE GROUND IS SHAKING!

You've got 30 seconds to save your life.

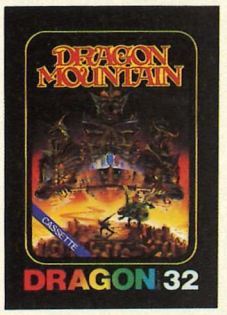
In reality, you're in your living room with your TV set and your new Dragon 32 Family Computer.

In your mind, however, you're stuck in a seemingly unfathomable labyrinth. Holding a lamp and a dagger. And faced with incontrovertible evidence that nine heads are more dangerous than one.

You're playing an Adventure game. And the first thing that strikes you (no, it's not the hydra) is how real it all seems.



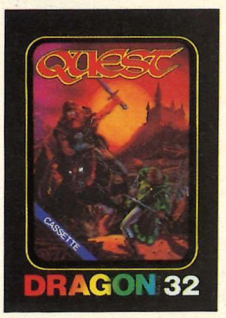
You play in dialogue with your computer - it tells you where you are, you tell it what to do. Your alternatives are virtually endless - and incredibly complex. You can play for days and still not solve the mystery. But



one thing you will be learning: more and more about how your computer works.

Dragon Software offers an impressive range of Adventure games. If your taste takes you into underground labyrinths, you can play Madness and the Minotaur (described above).

Alternatively, take yourself on a Caribbean treasure hunt with Calixto Island. Pit yourself against a slightly less friendly dragon in Dragon Mountain. Captain your own mediaeval army in Quest. Or search the desert for the evil sorcerer in El Diablero.



Dragon's Adventure games are just one facet of our growing range of software. You'll also find popular arcade-type games like Cosmic Invaders, Meteoroids and Astroblast.

Helpful programs like Personal Finance - a computerised filing system to help you organise the family's finances.

And educational programs like our Typing Tutor, which utilises the Dragon's own high-quality keyboard to teach you to type. And the range is growing month by month.

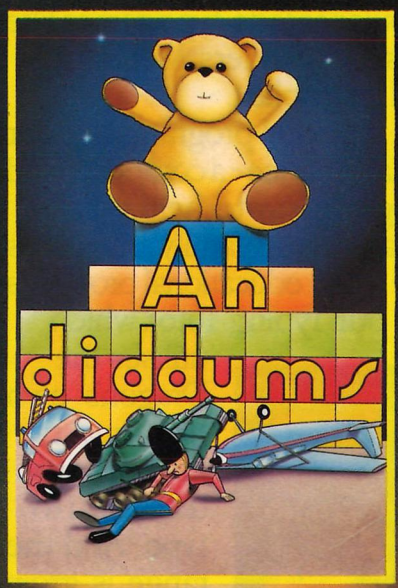
Dragon owners already know all about the quality of their computer. And Dragon software is specially designed to help you learn more and more about the machine's incredible capabilities.

And that's the biggest adventure of all.

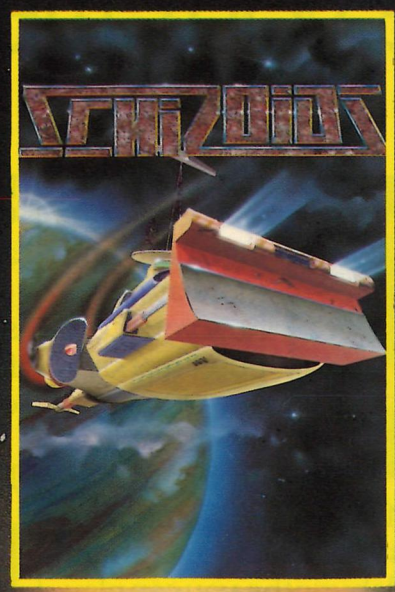
DRAGON 32

The first family computer.

How are yours



With Teddy
(for any ZX Spectrum)



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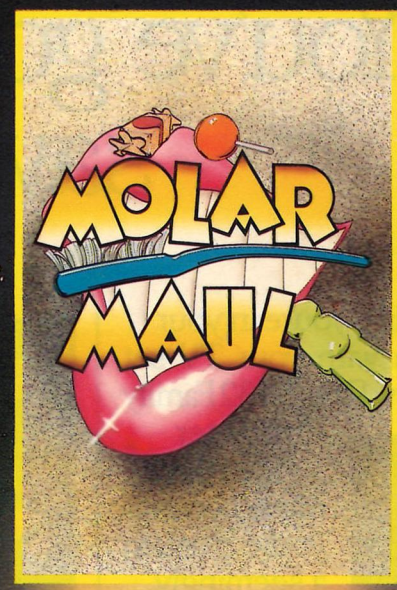

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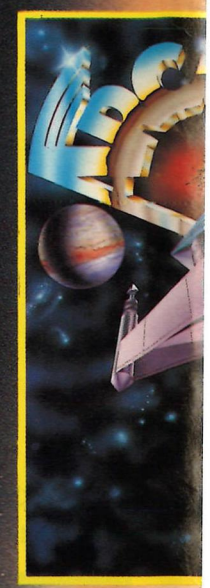

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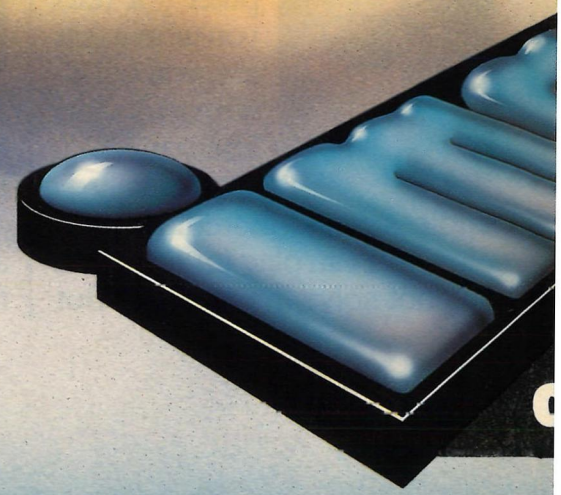

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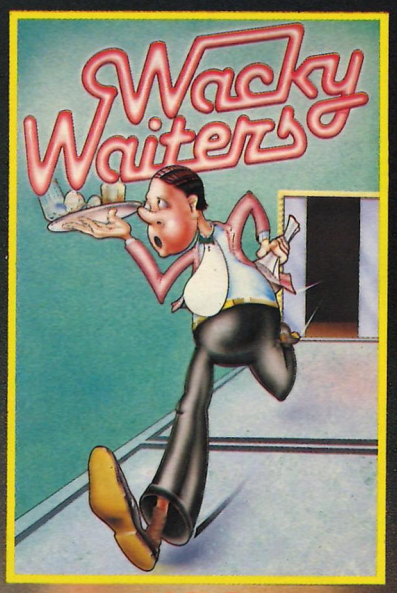

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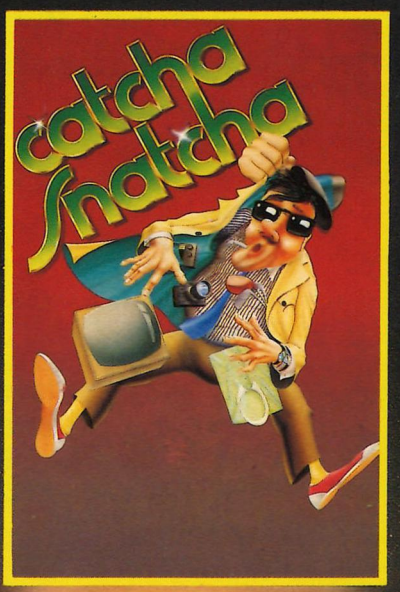

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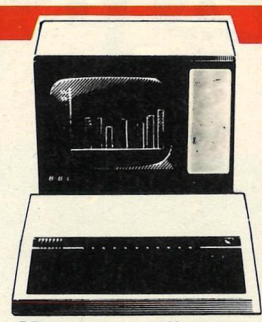

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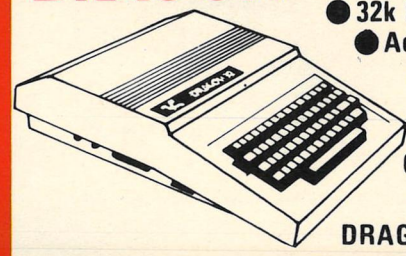

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AM400 + Cassette + 10xC12 – £199.00
Starter Pack 2
AM400 + Cassette + Basic + 10xC12 – £239.00

EXPORT

SINGLE or QUANTITY EXPORT orders welcome. NO VAT.
Experience of exports worldwide - full documentation.

TERMS. U.K. - Payment with Order.
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CASTLE ELECTRONICS

(0424) 437875

CASTLE ELECTRONICS Dept. YC.
7 CASTLE STREET, HASTINGS, E.SUSSEX

Our Sister Company SOUTH EAST COMPUTERS, is No.1 in the South for Business Systems

Announcing more exciting programs for the BBC.

Acornsoft is the software division of Acorn Computers, the company that designed and built the BBC Microcomputer. Here are four more exciting programs, all designed to get the most from your BBC Micro.

Starship Command (£9.95) is a demanding high-resolution graphics game in which you command a starship against attacking alien ships. You control the forward drive and rotational thrust of your ship, which is equipped with shields, long and short-range scanners and a sector display of the stars and alien ships.

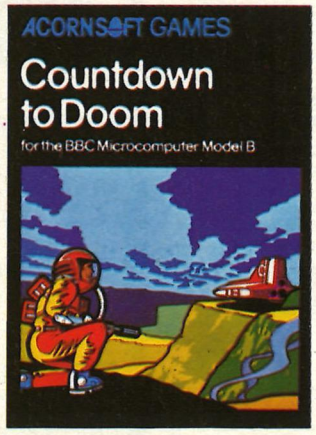
Countdown to Doom (£9.95) is a race against time as you strive to repair your damaged space ship in the corrosive atmosphere on the planet Doomawangara (Doom). Beat the clock or resign yourself to a life in the wilderness of Doom.

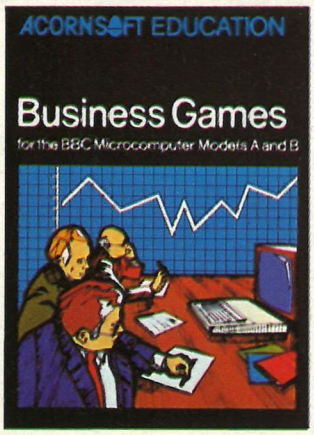
Business Games (£9.95) is a cassette containing two games designed for economics, business or general studies teaching.

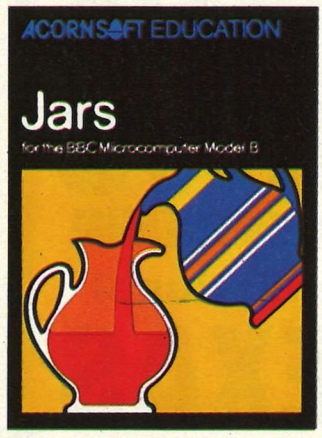
In Stokmark, up to eight players compete in buying and selling shares aided by a screen display of relevant market information.

In Telemark, players compete to dominate in the manufacture and sale of televisions. The winner is the one who makes the largest profit or controls over half the total market.

Jars (£11.90) is an educational cassette suitable for 7-13 year olds. The objective of the program is to present, what are usually thought of as purely numerical problems, in a visual way. Jars of liquid are used to visualise volume estimation and fraction problems. Success, partial success or failure is noted by a scoring system and suitable comments.







How to get Acornsoft programs.

If you're a credit card holder and would like to buy cassettes of the programs shown in this advertisement, or if you would like to know the address of your nearest stockist, just phone 01-200 0200.

Alternatively, you can buy the cassettes directly by sending off the order form below to: Acornsoft, c/o Vector Marketing, Denington Estate, Wellingborough, Northants NN8 2RL.

Also use this form if you would like to receive the current free Acornsoft catalogue.

Please allow 28 days for delivery.

☎ Credit Card Holders. Telephone 01-200 0200.

To: Acornsoft, c/o Vector Marketing, Denington Estate, Wellingborough, Northants NN8 2RL.

Please send me the following:–

PROGRAM	PRICE	QUANTITY	TOTAL	(Code Acornsoft use only)
Starship Command	£9.95			SBG22
Countdown to Doom	£9.95			SBG19
Business Games	£9.95			SBE03
Jars	£11.90			SBE15
		TOTAL		

I enclose PO/cheque payable to Acornsoft Ltd.
Or charge my credit card.
Card Number_____
(Amex/Diners/Visa/Access (Delete)
Please send me the Acornsoft brochure ☐
Name_____
Address_____
_____ Postcode_____
Signature_____

Registered No. 1524763. VAT No. 215 8123 85

ACORNSOFT

spectrum

NEWS from SPECTRUM

Sensational TEXAS OFFER!

Fantastic reductions & offers on the TEXAS TI-99/4A see our ad. on next double page for details.

PRESTEL

See PRESTEL Page 600181 for up to date information from SPECTRUM

NEW SPECTRUM MEMBERS

Check our address page! - there are many new **SPECTRUM** dealers throughout the UK so there's a good chance there'll be a **SPECTRUM** centre near you.

VIC-20 Package Offer!

A sensational package offer on this top selling micro. A complete computer system for only £139.99 - see our advertisement for full details.

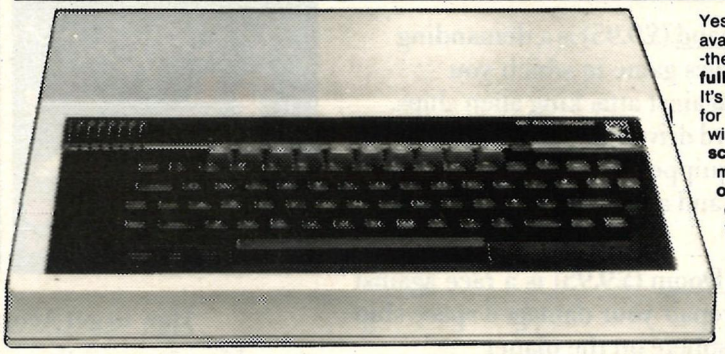
AFTER SALES CARE

SPECTRUM service centres will ensure that should your machine 'go down' **we will get it running again as quickly as possible.** We also offer **extended warranties** at reasonable prices too! - ask your **SPECTRUM HOME COMPUTER CENTRE** for full details.

COMPUTER DEALERS

The **SPECTRUM** dealer list is virtually closed. If your area is free and you'd like to join the waiting list, please write to **MIKE STERN, Spectrum (U.K.) Ltd, Burrowfields, Welwyn Garden City, Herts.**

BBC Model 'B' MICRO



Yes, this **top selling Micro system** is now available from your local **SPECTRUM** dealer -the **BBC Model'B'** offering **32K RAM** plus a **full back-up** of **peripherals** & **software** too! It's an **infinitely expandable** machine, ideal for the **home or business** and is already widely used for **educational purposes in schools** -so the chances are **your** children may already be **well familiar with its operation,** which must make it the **ideal choice** for the **home** too! So if you're thinking of buying a micro you **must** take a look at the **BBC** at your local **SPECTRUM** dealer **NOW!** - but just one word of warning, initially stocks will be limited and **demand is bound to be great,** so please 'phone to check the stock position before making a journey.

BBC 'B' with Disk Interface	£470.50
BBC Disk Interface Kit	£95.00
BBC Single Disk Drive 100K	£265.00
BBC Dual Disk Drive 800K	£803.85
BBC Tape Recorder	£29.90
BBC Acorn Software Cassette based from	£9.95
BBC Disk based software	£11.50

Spectrum Price

£399.00 INC. VAT

Please Note!

We regret that there is a tremendous shortage on all BBC equipment — please phone your nearest store before making a journey to check stock position.

SHARP MZ-80A

Desk top genius! the all-in-one SHARP MZ-80A. Ready to run the moment you get it home. Built-in keyboard. CRT. 9" display and cassette data storage with **48K RAM.** The BASIC with extra useful additions, offers quite a powerful micro for the home or business. ■ 4K Byte ROM 48K Byte RAM · 2K Byte Video RAM ■ ASCII profiled keyboard · numeric pad ■ 2page Video RAM allows screen to be scrolled up or down. ■ CP/M available.

Spectrum Price **£546.25** Inc. VAT

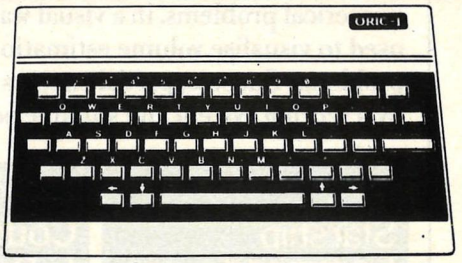
Floppy Disks and Accessories for MZ80A

Twin Floppy Disk unit (inc. 1/0 Card, Disk, Cable)	£856.75
Twin Disk Unit (only)	£678.50
Single Floppy Disk Unit	£460.00
Cable for F/D Drive	£29.79

Printers and Accessories for MZ80A, MZ80B & MZ80K

80 Col Tractor Feed Printer inc. Cable. 1/0 Card & Rom	£477.25

ORIC-1



A superbly designed and engineered micro and great value-for-money from **SPECTRUM.** Offering **48K RAM Colour** - (8 foreground and 8 background can be displayed at same time) **High resolution graphics User definable Graphics. Full sound** (6 octaves of controllable sound) **Easy to use keyboard with moving keys. Standard Centronics parallel interface allows** easy connection to a wide range of printers etc

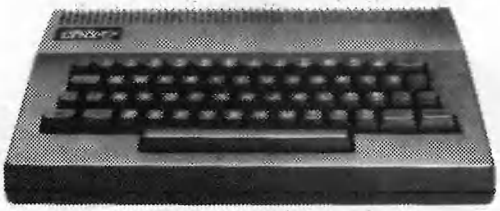
Spectrum Price **£169.95** Inc. VAT

SPECTRUM FACTS

Maximum user RAM	47,870 Bytes
Text screen	28x40
High Resolution	240x200
Cassette Lead	Included

Not all stores carry every advertised item, please phone before making a journey — Prices correct at time of going to press E. & O.E.

The powerful and infinitely expandable LYNX



Just look at this **super new LYNX Micro - an incredible** 16K & 32K video ram and that's expandable up to or beyond 96K. For just **£225.00 INCLUDING VAT** the **LYNX is exceptionally versatile.** All **LYNX's** 'add-on' connections are **standard types.** The high definition **colour graphics** make it a **top value choice** for the **home or office** (with expansion, the **LYNX** can become an 80 characters-per-line word processor!) Take a look at the **LYNX** - a memorable bargain from **SPECTRUM.** But please phone to check stock position before making a journey as this machine is bound to be in **great demand.**

Spectrum Price

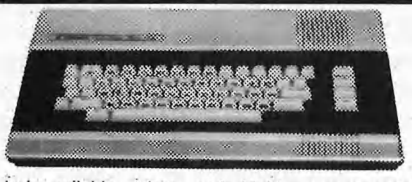
£225.00 Inc. VAT

VISCOUNT - Teach yourself LYNX BASIC **£6.95**

SPECTRUM FACTS

Maximum user RAM	13,700 Bytes (approx)
Text Screen	24x30
High Resolution	265x248
Cassette Lead	Included

COLOUR GENIE



A truly reliable micro and highly recommended by **SPECTRUM** featuring powerful and sophisticated COLOUR GRAPHICS, allowing you to create full 8-colour Games, Diagrams and charts quickly and simply. Powerful 16KK RAM memory (expandable internally to 32K) for FULL COLOUR video games and POWERFUL COMPUTING with a full range of inexpensive accessories: 16K RAM pack, Joysticks for TV games, Light Pen, Disk Drive and a Printer. The superb Colour Genie is at SPECTRUM now - check it out and see the Genius at work!

NEW Low Price £194.00 Inc. VAT

COLOUR GENIE ACCESSORIES

Joysticks	£49.49
16K RAM	£38.50
Printer Interface	£39.95
VISCOUNT Teach yourself Colour Genie Basic	£6.95

SPECTRUM FACTS

Maximum user RAM	**14,200 Bytes (approx)**
Text screen	**24x40**
High Resolution	**320 x 192**
Cassette Lead	**Included**

SINCLAIR ZX SPECTRUM

Yes, this top selling micro is now available from Spectrum in both **16K** and **48K RAM.** So now there's no need to send by Mail Order - just call into your local SPECTRUM dealer and pick one up. But just one word of warning: with this added avilability advantage, stocks are bound to sell fast - so make it soon!

SINCLAIR ZX SPECTRUM 16K - £99.95
SINCLAIR ZX SPECTRUM 48K - £129.95

Spectrum Computer Centres have no connection whatsoever with the ZX-Spectrum Computer manufactured by Sinclair Research Ltd.

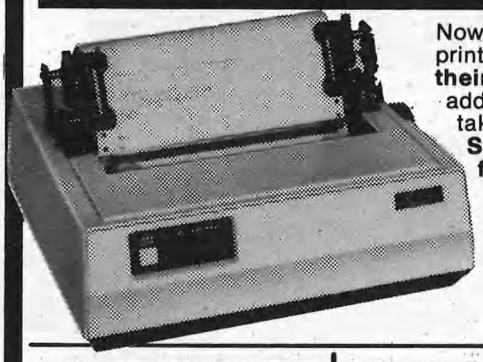
SINCLAIR ZX-81

SINCLAIR ZX . . . £49.95
16K RAM pack . . £29.95
ZX Printer £39.95

Computer Bookshop Software for Sinclair Computers	**INC. VAT**
Bumper 7 1K ZX81	£5.95
1K Super Trio ZX81	£7.95
Labyrinth 16K ZX81	£5.95
Nightmare Park/Music 16K ZX81	£6.95
Computacalc 16K ZX81	£7.95
Personal Banking System 16K ZX81	£11.44
Space Invaders/Rescue 16K ZX81	£6.95
Breakout 16K ZX81	£5.95
Mugsy 16K ZX81	£5.95
Mergatroyds 16K ZX81	£5.95
Progmerge 16K ZX81	£5.95
Football Manager 16K ZX81	£7.95
Cassettes for ZX81 Type—10	
6 Games	£3.95
Junior Education	£3.95
Business & Household	£3.95
Skill & Judgement Games	£3.95
Junior Education	£3.95
Family Quiz	£3.95
Type—20	
Fantasy Games	£4.75
Space Raiders & Bombers	£4.75
Type—30	
Super Programs Nos. 1-8	£4.95
Type—40	
Backgammon	£5.95
Flight Simulation	£5.95
Type—50	
English Literature 1	£6.95
English Literature 2	£6.95
Geography	£6.95
History 1	£6.95
Maths. 1	£6.95

ZX-PANDA
16K RAM PACK
ONLY £24.95

OKI MICROLINE Printers



Now from **SPECTRUM** - this **top selling** range of printers **renowned throughout the world for their quality and reliability.** If you're thinking of adding a printer to your micro then you must take a look at the **MICROLINE** range at **SPECTRUM -NOW!** they're **fantastic value-for-money**

Models available

MICROLINE Model 80 £259.90
MICROLINE Model 82A £455.40
MICROLINE Model 92P £585.35

EPSON

The new EPSON RX-80 and FX printers now available—check with your local SPECTRUM dealer NOW!

FX-80 Spectrum Price £503.70
RX-80 Spectrum Price £332.35

SEIKOSHA

GP-100A

Now a top quality graphic printer at a price you can afford. Centronics interface connects easily with most micros.
Spectrum price **£229.94** Inc.
VAT Cables & Interfaces available for most micros

SMITH CORONA

Model TP-1

Microprocessor controlled, high quality daisy wheel printer at a LOW cost from SPECTRUM. Serial, Parallel or IEEE Interface.
Spectrum LOW price **£557.75** Inc. VAT

BOOKS

SELECTION FROM THE COMPUTER BOOKSHOP

30 Hour Basic for the BBC Micro	£5.95
Let your BBC Micro Teach You to programme	£6.45
BBC Micro Revealed	£7.95
Over the Spectrum	£6.95
60 Games and Applications for the ZX Spectrum	£4.95
Programming the 6502	£9.95
Programming your ZX Spectrum	£6.95
ZAP Pow Boom for the Vic 20	£7.95
The ZX Spectrum Explored	£5.95
Vic Inovative Computing	£6.95
Mastering Machine Code on your Zx81	£7.50

The ZX Spectrum and how to get the most from it	£5.95
Easy Programming for the ZX Spectrum	£5.95
30 Programmes for the BBC Micro	£4.95
CPM Handbook	£11.50
Programming the Z80	£11.95
20 Best Programmes for the ZX Spectrum	£5.95
Getting aquainted with your Vic 20	£6.95
Machine code and Better Basic	£7.50
The Cambridge Colour Collection (Spectrum)	£6.95
Vic Revealed	£10.00
De RE Atari	£17.00
ATARI Operating system listing	£10.43

MORE SPECTRUM LOW PRICES

Spectrum Computer Centres have no connection whatsoever with the ZX-Spectrum Computer manufactured by Sinclair Research Ltd.

spectrum

A truly amazing offer on this expandable & Comprehensive top-of-the-line Micro.

Yes, now from **SPECTRUM** the **fabulous TEXAS TI-99/4A** Home Micro at a **super NEW LOW PRICE - Plus!** a super **FREE!** offer too! When you return your **FREE OFFER VOUCHER** obtainable at time of purchase to **TEXAS INSTRUMENTS** they will send you **absolutely FREE!** a **PAIR OF JOYSTICKS - worth £24.95. A beginners BASIC TUTOR PROGRAM -Worth £9.95** and a **CONNECT 4 PROGRAM - Worth £15.95. TOTAL VALUE £50.85** (which means you're effectively **only paying £99.10** for your **TEXAS TI-99/4A micro.) A fantastic offer - HURRY** to your local **SPECTRUM** dealer **NOW** and see for yourself just what **great value this really is.** Offer closes June 30th.

Plus! FREE!

Goods worth £50.85

FREE! Pair of Joysticks worth £24.95

FREE! Beginners BASIC Tutor program worth £9.95

FREE! Connect Four program worth £15.95

With every TEXAS TI-99/4A purchased. See opposite for details.

Super NEW LOW PRICES on TEXAS SOFTWARE from Spectrum too!

The Spectrum top 30

Connect Four	£15.95	Oldies but Goodies	£12.95		
Zero Zap	£15.95	Soccer	£24.95	Adventure & Pirate	£29.95
Attack	£15.95	Tomb Stone City	£24.95	Adventure Land	£19.95
Blasto	£15.95	Munchman	£29.95	Mission Impossible	£19.95
Hustile	£15.95	Chess	£39.95	Voodoo Castle	£19.95
Yahtzee	£15.95	Parsec	£29.95	The Count	£19.95
Hangman	£15.95	Alpiner	£29.95	Strange Odyssey	£19.95
T.I. Invaders	£19.95	**EDUCATIONAL GAMES**		Mystery Funhole	£19.95
A-maz-ing	£19.95	Dragon Mix	£27.95	Pyramid of Doom	£19.95
Wumpus	£19.95	Aligator	£27.95	Ghost Town	£19.95
Carwars	£19.95	**ADVENTURE PROGRAMS**		Golden Voyage	£19.95

PLUS! FREE!

SPEECH SYNTHESISER or TI CASSETTE RECORDER each worth £49.95

When you buy any 6 Texas Software modules.

An additional **BONUS OFFER** from **SPECTRUM!** Purchase 6 (or more) **TEXAS software modules** - send your receipt to **TEXAS INSTRUMENTS** and you'll receive a **FREE SPEECH SYNTHESISER** or a **TEXAS TI CASSETTE RECORDER** each **worth £49.95** -ask your local **SPECTRUM** for details NOW!

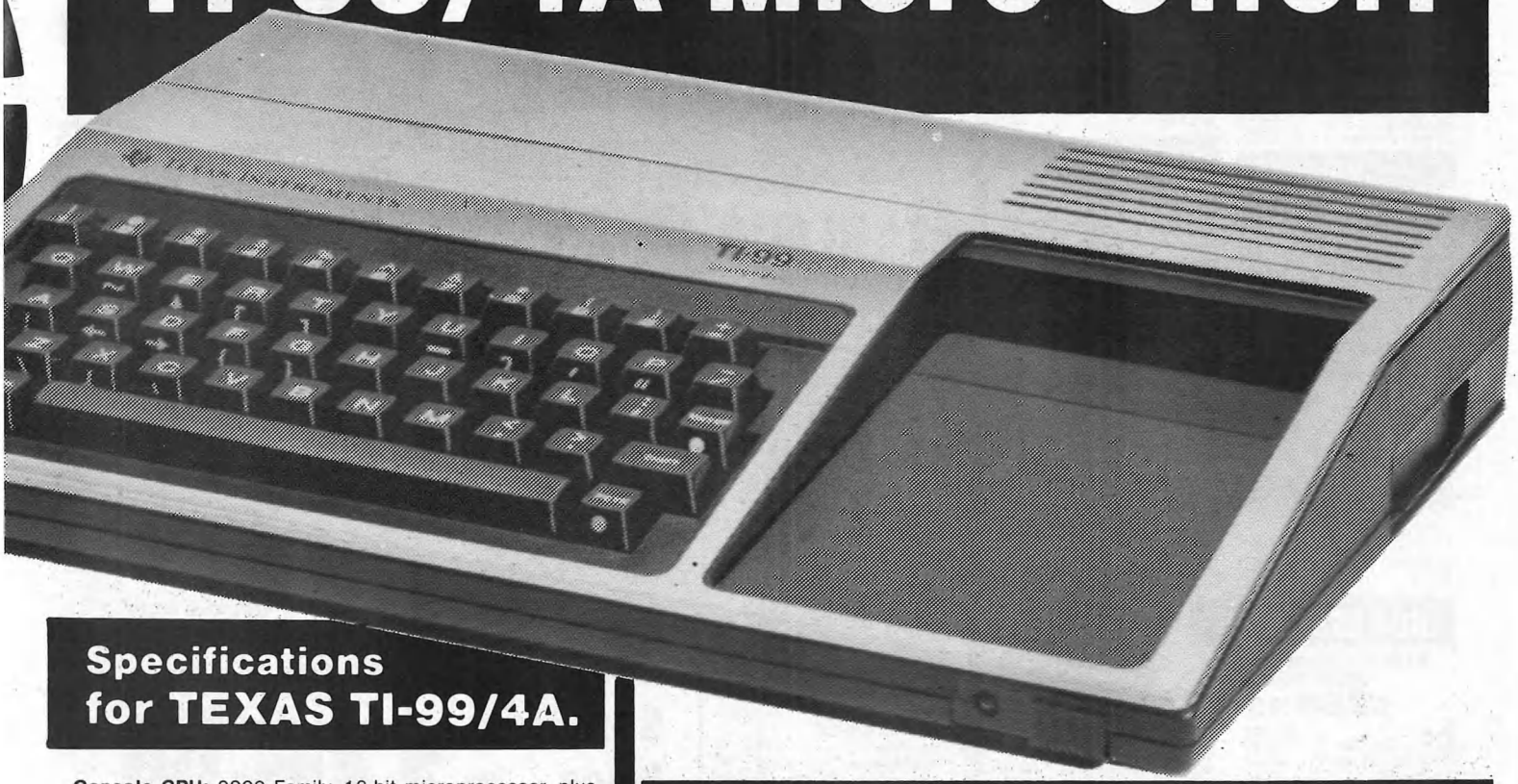
TEXAS TI-99/4A - just part of a complete system.

The **TEXAS T1-99/4A** is just part of a **complete system** which can be **expanded simply & easily** with **optional peripherals (disk drives, printers etc.)** and **easy-to-use Solid State Software modules.** A system which **will meet your needs today & tomorrow** - a system you can **grow with** as and when the needs arise. It can use up to **4 different programming languages** and more than **600 software programs** are available worldwide. Last but not least-it comes from the people with the **greatest experience in microprocessors-the inventors themselves:** so if you're considering buying a home micro you **must** take a look at the **TEXAS TI-99/4A** at your local **SPECTRUM dealer NOW - it really is a terrific buy!**

Unbelievable but true!

TEXAS

TI-99/4A Micro Offer!



Specifications for TEXAS TI-99/4A.

Console CPU: 9900 Family, 16-bit microprocessor, plus 256-byte scratchpad RAM.
Memory: Total combined memory capacity: 110 KBytes. Internal ROM memory supplied: 26 KBytes. External ROM memory: (Solid State Software® command modules) up to 36 KBytes each.
RAM memory supplied: 16 KBytes (Expandable to 48 KB).
Keyboard: 48 key QWERTY with control and function keys (user definable), full upper and lower case capability, alpha lock, auto repeat.
Sound: 5 octaves, 3 simultaneous tones plus noise generator. Each tone controlable in 1Hz steps from 110 Hz to beyond the audible range.
Colours: 16 foreground and background colours.
Video resolution: 192 x 256 (24 x 32 characters).
Power: 240V - 50Hz - 25W in seperate power supply unit.
I/O: UHF modulated PAL colour signal for UK TV receivers.
I/O: UHF modulated PAL-Colour signal for connection to your own T.V. Interface for up to 2 domestic audio cassette recorders. 44-pin peripheral connector-up to 3 peripherals attached simultaneously. System memory and address signals available at peripheral connector. Interface for 2 Wired Remote Controllers.
Built in Software: 14 KByte BASIC interpreter. Internal Graphics Language interpreter, not user accessible. Internal 4.4 KByte monitor (not user accessible).

SPECTRUM SENSATIONAL PRICE - NOW ONLY

£149.95

INC. VAT

MORE SPECTRUM LOW PRICES

Spectrum Computer Centres have no connection whatsoever with the ZX-Spectrum Computer manufactured by Sinclair Research Ltd.

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A few examples from our

SOFTWARE Selection

from independent software houses

THORN EMI

Software for ATARI	Inc. VAT
Submarine Commander	£34.44
Jumbo Jet Pilot	£34.44
Soccer	£29.84
Kickback	£29.84
Home Financial Management	£19.49
Darts	£19.49
Snooker & Billiards	£19.49
Pool	£19.49
Cribbage & Dominoes	£19.49
Cupute 4 & Reversi	£14.89
Mutant Herd	£24.25
Software for Commodore	
River Rescue	£25.24
Vic Music Composer	£25.24

GEM

Software for ZX81, Dragon and Spectrum	Inc. VAT
Monster Mine (for ZX81)	£4.95
Monster Mine (for Spectrum)	4.95
Monster Mine (for Dragon)	7.95
Space Mission (for ZX81)	£4.95
Space Mission (for Spectrum)	£4.95
Space Mission (for Dragon)	£7.95
Dragon Golf	£7.95
Dragon Character Generator	£9.95

SALAMANDER

Games for Dragon 32	Inc. VAT
Dragon Trek	£9.95
Wizard War	£7.95
Vulcan 0	£7.95
Games Compendium DI	£7.95
Golf	£7.95

RABBIT

Software for Commodore VIC20	Inc. VAT
Space Storm	£6.99
Ski Run	£4.99
Dune Buggy	£4.99
Super Worm	£4.99
Jungle	£4.99
Cosmic Battle	£4.99
Frogger(3K)	£4.99
Rabbit Functions	£4.99
Code Breaker	£4.99
Night Fight (3K)	£4.99
Rabbit Writer (16K Cassette)	£19.99
Rabbit Base (16K Cassette)	£14.99
Myriad (3K)	£9.99
Charset/20 (3K)	£4.99
Skramble	£9.99
Space Phreeks	£9.99
Night Crawler	£9.49
Hopper	£9.99
Tank War	£7.99

KUMA

Software for Sharp	
Electron 22622	£9.20
Cribbage	£12.08
Adventure	£12.08
Chess	£16.68

AUDIOGENIC

Programs for VIC-20	Inc.VAT
Amok	£6.95
Alien Blitz	£7.95
Golf	£7.95
Spiders of Mars	£19.95
Sattelite & Meteorites	£19.95
Bonzo	£7.95
Trashman	£19.95
Boss	£14.95
Tank Attack	£19.95
Word Craft	
Word Processing package	£125.00

Plus many more at your local SPECTRUM dealer -call in now and see!

ACCESSORIES

SANYO Colour Monitor CDD3125NB

£286.35

SANYO	Inc. VAT
SANYO 12" green monitor	£113.85
Slim 3G Cassette Recorder	£29.95
C12 Cassettes	£0.50
Single sided double density disks (Box of 10)	£21.25
Double sided, double density disks (Box of 10)	£33.81
Disk head cleaner	£16.10
Single part 11" x9½" printer paper, box of 2,000 sheets	£13.05
VIC Accessories from Viscount	
Motherboard without Buffer	£24.95
Motherboard with Buffer	£29.90
16K RAM Pack	£43.95
32K RAM Pack	£66.95
64K RAM Pack	£114.94
Adman Chatterbox Voice Synthesiser	£57.45

Fantastic! NEW LOW Price

ATARI 800

Now this proven and tested machine has been upgraded to a massive **48K RAM** and its still at the amazing **LOW** price of**£399.99** from **SPECTRUM.** It's an ideal Home Micro for graphics, educational and personal finance etc. use it and it will take you from learning up to a small business use. You can add printers, program recorders, disk drives and more, to expand your micro as and when you want, to suit your needs. So if you're looking for a top of the line micro you must see the **ATARI 800** with **48K** at **SPECTRUM - NOW!**

Sensational Price

£299.95 INC. V.A.T.

SPECTRUM FACTS

Maximum user RAM	37,899 Bytes
Text Screen	24 × 40
High Resolution	320 × 192
Cassette Lead	Needs own Recorder

ATARI 400

16K RAM

NOW ONLY £149.95 INC. VAT

including FREE Programming Kit
BASIC cartridge extra
£39.99 inc. VAT
(£34.77 ex. VAT)

SPECTRUM FACTS

Maximum user RAM (with basic Cartridge)	13,323 Bytes
Text Screen	24 × 40
High Resolution	320 × 192
Cassette Lead	Needs own Recorder

ATARI DISK DRIVE £299.00 INC. VAT

DRAGON

Incredible Value-for-Money!

Extensive facilities include highly advanced colour graphics. Powerful standard 32K RAM (expandable to 64K Bytes). ● 9 Colour 5 resolution Display ● Extended Microsoft colour BASIC (as standard) ● Advanced sound with 5 octaves -255 tones.

SPECTRUM FACTS

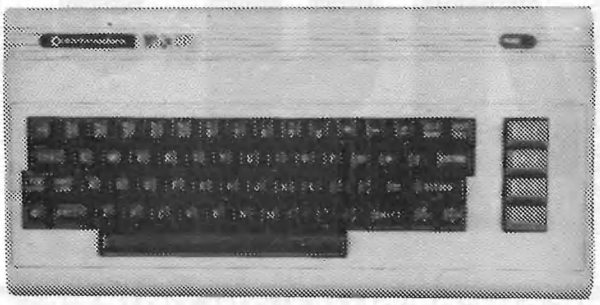
Maximum user RAM	29,679 Bytes
Text Screen	16 x 32
High Resolution	256 x 192
Cassette Lead	Included

VISCOUNT Teach yourself Dragon Basic £6.95

Spectrum Price only £175.00 INC. VAT

Commodore VIC-20 'Package Deal'

SENSATIONAL VALUE!



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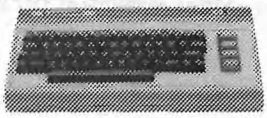

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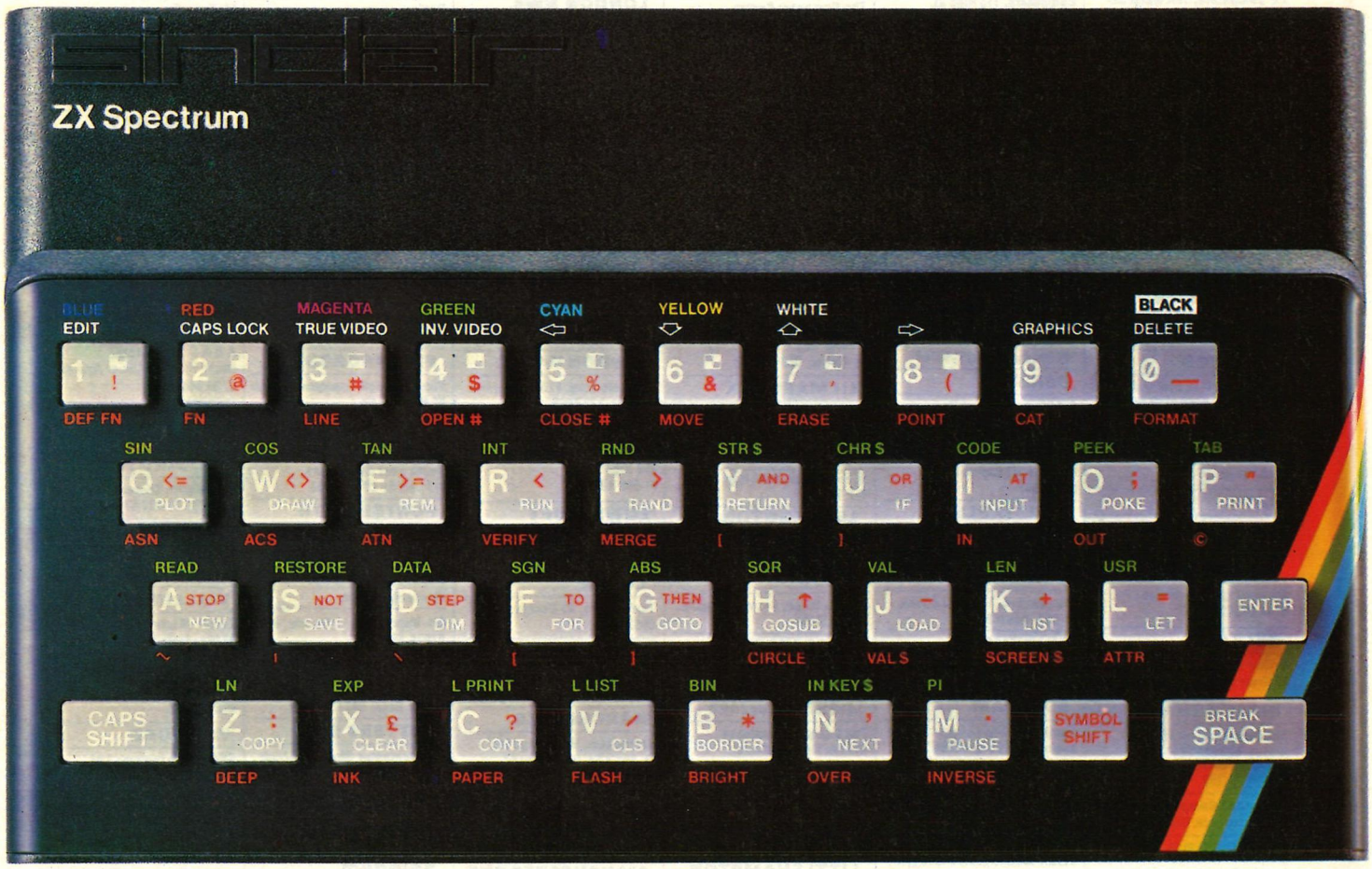

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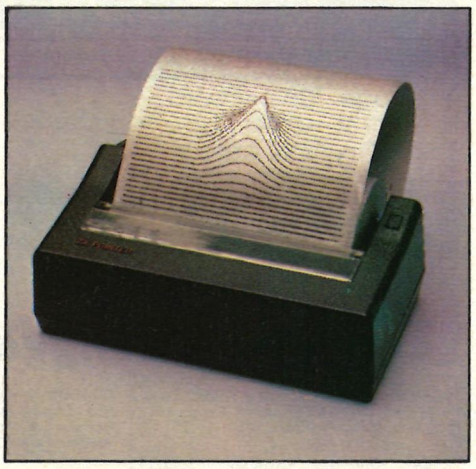

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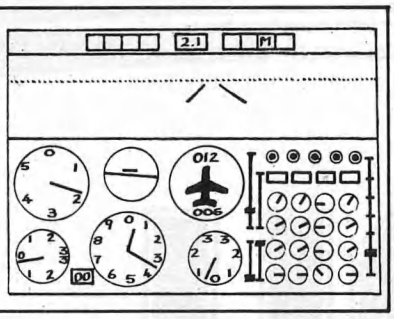

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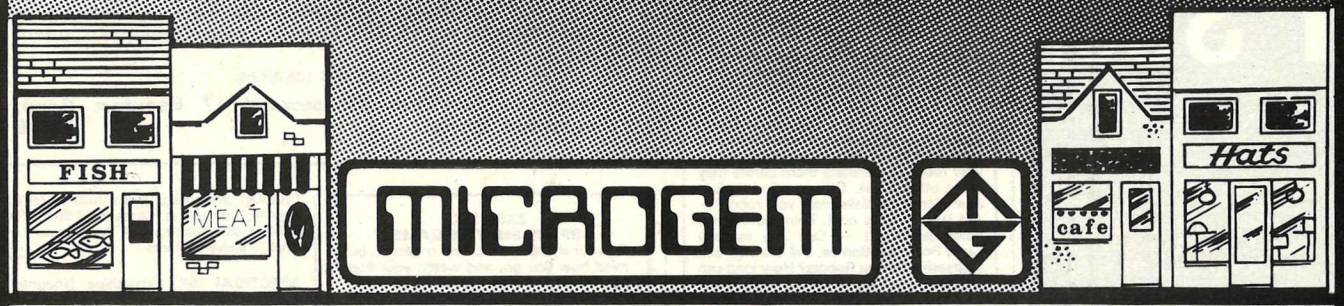

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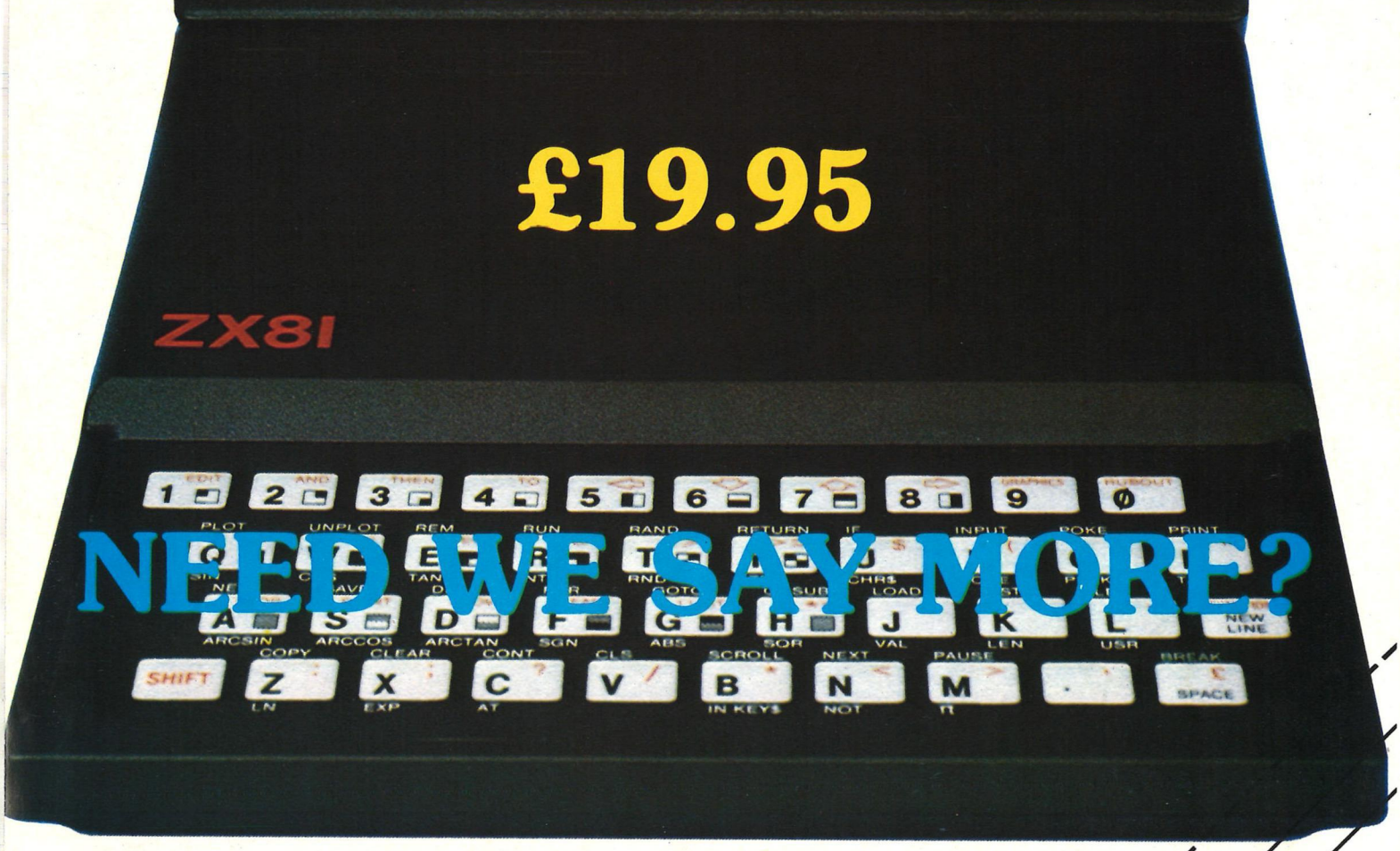

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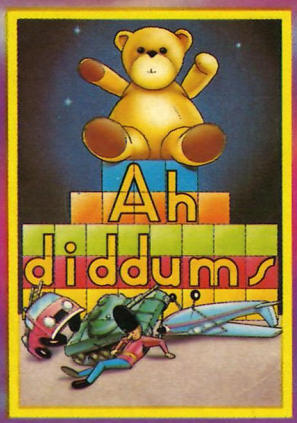

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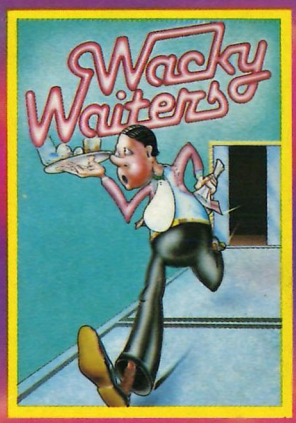

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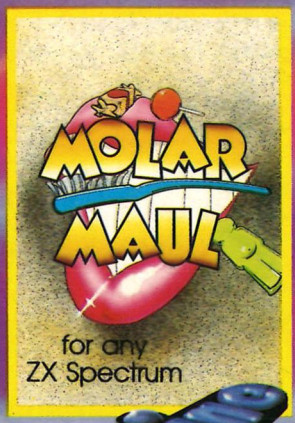

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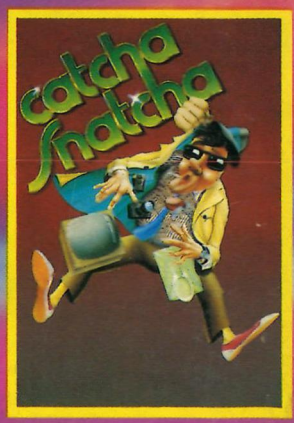

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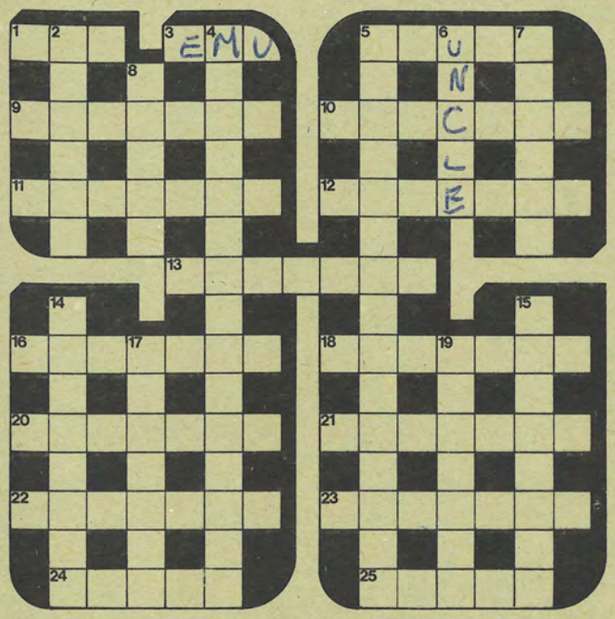

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1 A secret service with long ears! (3)
2 In the music recognise a bird (3)
5 Reckon it's a title (5)
9 Polish the right chips for headings (7)
10 Whip the Queen, giving an unsteady display (7)
11 1049 + 51, on 10^6 (7)
12 Having unusual fun with lute can be melodious (7)
13 Take off the capricious (3-4)
16 Set fair in a rut (2, 5)
18 Turn on, and gain influence over (5, 2)
20 Need reference to two dozen sheets (7)
21 Stresses mains with money (7)
22 Gives up on bad singers (7)
23 Large heads that cover rings (3, 4)
24 Sound or bad coins? (5)
25 Off-course satyr (5)

DOWN

2 It's dull, but it puts back half an idea (6)
4 Two chips and one ROM choose Reagan to describe 5D (15)
5 Estimator has flaws in the summer! (10, 5)
6 Relative with Sam in America (5)
7 Ready to strike oddly, reputed headless (4, 2)
8 Fish for a goblin (5)
14 Numbers have risen — get organised! (8)
15 5D operation of the times (8)
17 Get together again and ruin one (7)
19 Choose about almost half 4D (7)

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